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RESOURCES & INDUSTRIES

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BULLETIN

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THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

December 1942 and 1943

SOURCE AND DISPOSAL OF ENERGY—MONTH OF DECEMBER

	1943	1942	%
GENERATION* (Net)			
By Fuel Burning Plants	14,659,000,000	11,571,400,000	+26.7
By Water Power Plants	5,591,903,000	6,109,800,000	− 8.5
Total Generation	**20,250,903,000**	**17,681,200,000**	**+14.5**
Add—Net Imports over International Boundaries	121,431,000	126,200,000	− 3.8
Less—Company Use	241,347,000	226,200,000	+ 6.7
Less—Energy Used by Producer	907,728,000	360,000,000	+152.1
Net Energy for Distribution	**19,223,259,000**	**17,221,200,000**	**+11.6**
Losses and Unaccounted for	2,301,514,000	2,474,481,000	− 7.0
Sales to Ultimate Customers	**16,921,745,000**	**14,746,719,000**	**+14.7**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of December 31st			
Residential or Domestic	26,884,015**	26,620,456	+ 1.0
Rural (Distinct Rural Rates)	1,088,695	1,095,512	.....
Commercial or Industrial:			
Small Light and Power	4,171,237	4,219,457	− 1.2
Large Light and Power	146,729	149,928	
Other Customers	120,027	125,087	.....
Total Ultimate Customers	**32,410,703**	**32,210,440**	**+ 0.6**
KILOWATTHOUR SALES—During Month of December			
Residential or Domestic	2,622,211,000**	2,522,490,000	+ 4.0
Rural (Distinct Rural Rates)	215,584,000	187,300,000	+15.1
Commercial or Industrial:			
Small Light and Power	2,589,046,000	2,365,678,000	+ 9.4
Large Light and Power	9,577,620,000	8,187,599,000	+17.0
Street and Highway Lighting	214,050,000	215,835,000	− 0.8
Other Public Authorities	914,961,000	438,958,000	+108.4
Railways and Railroads:			
Street and Interurban Railways	459,278,000	444,340,000	+ 3.4
Electrified Steam Railroads	239,820,000	226,829,000	+ 5.7
Interdepartmental	89,175,000	157,690,000	−43.4
Total to Ultimate Customers	**16,921,745,000**	**14,746,719,000**	**+14.7**
Revenue from Ultimate Customers	**$274,761,300****	**$255,710,600**	**+ 7.5**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For the 12 Months Ended December 31st			
Kilowatthours per Customer	1,069	1,022	+ 4.6
Average Annual Bill	$38.91	$37.51	+ 3.7
Revenue per Kilowatthour	3.64¢	3.67¢	− 0.8

(*) By courtesy of the Federal Power Commission.
(**) Above data reflects results of bi-monthly billings of certain large companies.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 12 MARCH, 1944 No. 3

The Other Side of the Mountain

Electric Companies Expect to Do Their Part in the Transition to Peace-Time Economy

By William M. Carpenter

Economist, Edison Electric Institute

WITH the passing of the peak of power demand, the electric utility industry enters a new phase. In place of the rapid expansion from a peace-time economy which has taxed to the utmost the country's ingenuity and resourcefulness, there is now in sight a contraction during the remainder of the war period, followed by a further change to post-war conditions. Instead of acute shortages, a list of surplus materials is beginning and, for the public utilities, there already is talk of the reappearance of idle generating capacity.

While it is still impossible to attempt an extensive forecast, several factors have developed, whose correct appraisal will furnish valuable clues, not only to the near future, but also to the volume of business and earning power of the utilities during the immediate post-war era.

Present indications point to a progressive decrease in war demand, offset, in part, by a resumption of civilian production. Instead of evaluating the electric load at some desirable level of national income and employment, this analysis has been undertaken, not so much as a prophecy, but rather as a realistic attempt to suggest the existence of various elements which will influence this transition to our post-war economy.

In regard to the generating capacity of the private companies, it may be concluded that, large as the probable excess may appear in contrast with the overloads of 1943, indications point toward a balance between capacity and use comparable to that existing in the average of the years 1936-37-38, which are becoming more and more clear as representing a reasonable approximation of the "normal" of the American economic structure. This inference is necessarily based on certain assumptions, which are outlined in the Appendix. A detailed estimate for the year 1947 appears in Table 1, which attempts to represent a reasonable approximation of the results of the various factors which will presently be enumerated. It will be noted that the large decrease in kwhr sold is confined to the low-priced power brackets and that the other classifications are expected to show a growth which is sufficient to maintain the gross revenue not far from the present boom-time level.

The whole structure of this estimate is, however, predicated on the still-to-be-established essential that the period of readjustment lying immediately ahead not only will produce no widespread political schemes which will even more seriously jeopardize business initiative, but also that some amelioration will be effected in the existing policies that are now eating away the hopes of the investor and the substance of private enterprise.* It also assumes no drastic change in utility rate-making procedure.

According to present plans, the installed capacity of the private utility companies will have increased, during the ten years, 1937-1947, from 31,900,000 to 39,500,000 kw. This gain of 7,600,000 kw represents a growth of only 2¼ per cent compounded per annum and compares with an increase of 8,540,000 kw during the previous ten years. Barring unforeseen events of exceptional importance: it seems reasonable to expect that total consumer sales from these installations will approximate 121.5 billion kwhr in 1947, indicating a use-factor of 3075 kwhr per kw which, while 27 per cent below the 4220 figure of 1943, compares very favorably with the average of 2725 for the three years 1936-37-38. This annual increase of 2¼ per cent contrasts with an estimated rate of growth in excess of 3 per cent before the war altered the normal business expansion of the country.

On this relatively modest basis of ex-

* "The single missing element in a great forward movement is a feeling of security—a belief that money can be spent or invested without confiscation of reasonable profits by inordinate taxation, that American assets will not again be subject to some great arbitrary change in the value of money, that there are to be no further disturbing assaults on business either by some statutory change in the existing business pattern, or a general governmental hostility or governmental competitive invasion of existing fields of private enterprise."—*Bernard M. Baruch, before the Senate Committee on Unemployment and Relief, Feb. 28, 1938.*

TABLE 1—SALES AND REVENUES FROM CONSUMERS—TOTAL INDUSTRY

Classification	*1947* Kwhr (billion)	*1947* Rev's (million)	*1947* Avg Price	*1943* Kwhr (billion)	*1943* Rev's (million)	*1943* Avg Price
Residential	35.5	$1,218	3.43¢	28.8	$1,048	3.64¢
Rural	4.0	100	2.50	2.9	82	2.86
Small commercial	34.0	877	2.58	29.1	780	2.68
Large commercial	53.5	587	1.10	106.0	954(a)	0.90(a)
Street lighting	2.7	92	3.56	2.1	77	3.67
Other public authorities*	2.6	41	1.58	8.9	96(a)	1.08(a)
Street railways	4.0	32	0.80	4.7	38	0.81
Elec. steam railroads	3.0	23	0.77	2.6	20	0.77
Interdepartmental	0.7	5	0.71	0.9	5	0.56
Total	140.0	$2,975	2.13¢	186.0	$3,100(a)	1.67¢(a)

* Most of this is industrial power sold to war plants financed by loans from the Reconstruction Finance Corporation.

(a) Preliminary figures.

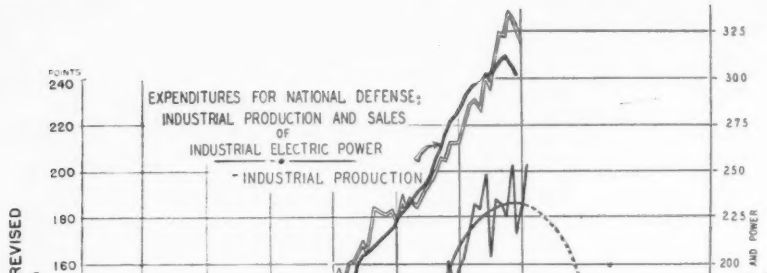

Figure 1

pansion, and with a use-factor equal to representative pre-war years, no unreasonable excess of generating capacity is apparent for the private companies. On the other hand, no signs appear of the necessity for any large expansion of this plant in the near future.

For the publicly-owned plants, however, the picture is different. Where the total increase in capacity of the private companies from 1937 to 1947 will probably amount to 7,600,000 kw, or 23½ per cent, that of the public plants will total at least 6,500,000 kw or 185 per cent, a large part of which is employed in the manufacture of aluminum. As outlined later in this discussion, it seems improbable that developments utilizing large quantities of aluminum or other products consuming great amounts of power in their manufacture can be effected rapidly enough to avoid a few years' period of over-capacity in some localities.

War Expenditures and Electric Output

The direct cause of the present business boom has been the contracts for materials and supplies placed by the Federal Government. It may be suggested that the sum total of Government expenditures is, like everything else, determined by economic forces and that the pattern of the over-all total will have certain determinable characteristics. If this is true and if the shape of the curve can be correctly interpreted, then the immediate future—again barring unsuspected developments—can be approximated.

Figure 1 shows the chart of industrial production, sales of industrial electric power and the curve of the average daily expenditure for war activities, determined by dividing the monthly totals published by the U. S. Treasury by the number of days in each month. Right from the start, the curve of war expenditure has assumed a shape with which all electrical engineers are familiar. Since the six-months' average of the nation's war expenditures has been decreasing since November, it seems likely that the crest has been passed and that the descending line will approximate, in its slope, the shape of the ascent. This has been indicated on the chart by the dotted line.

During the earlier days of the war, much sound and fury arose from those prophets of "power shortage" who based their forecasts on the thesis that the volume of government spending would cause a proportional increase in electric output which, in turn, would be superimposed upon an already high level of civilian production. This turned out differently; the factors used to translate dollars into electric power output were much too high and, instead of maintaining a constant level after the preliminary boom period, civilian output showed a considerable decline. It all ended, however, in the close relationship between industrial production, power output and war expenditures which is readily apparent in Figure 1.

If there was an element of truth in the underlying assumption that power output would grow while war expenditures increased, then it is within reason to assume that it will work with equal effectiveness as spending diminishes. On this basis the following table is presented for war expenditures and the sales of industrial power which they involve. Sales of industrial power for civilian uses are expected to approximate in 1947 the best of the pre-war years 1937 and 1939.

With the decrease in war demand outlined by Table 2, the estimate for 1947 will rest upon the amount of civilian business probable during the early post-

TABLE 2—WAR EXPENDITURES AND SALES OF ELECTRICITY

Year	*Expenditures for War (a)* (million $)	*War Materials as % of Total Production (b)*	*Industrial Power Sales (c)* — *Total* (million kwhr)	*Civil* (million kwhr)	*War* (million kwhr)	*Kwhr per $ Exp.*
1936	..	....	51,000	51,000	.. ..	...
1937	....	....	54,700	54,700	.....	...
1938	....	....	46,500	46,500	....	...
1939	....	....	54,800	54,800	.....	...
1940	$ 1,885	5%	63,500	60,325	3,175	1.68
1941	12,530	20%	80,000	64,000	16,000	1.28
1942	49,815	53½%	93,750	43,750	50,000	1.00
1943	81,860	66 2/3%	115,500	38,500	77,000	0.94
		ESTIMATES FOR NEARBY YEARS				
1944	79,000	65%	115,000	40,000	75,000	0.95
1945	35,000	45½%	87,500	47,500	40,000	1.14
1946	8,500	18%	64,000	52,500	11,500	1.35
1947	2,000	5%	58,000	55,000	3,000	1.67

(a) As reported by U. S. Treasury; does not include a relatively small amount furnished by Reconstruction Finance Corporation.

(b) As reported by Federal Reserve Board (Dec. Bulletin, p. 3).

(c) Total of "large light and power," a part of "sales to other public authorities" and a part of "rural" sales. Millions of kilowatthours.

war years. On this point there are sharp differences of opinion, depending on the appraisal of the following factors:

Post-War Forecasts

It is commonplace to observe that a host of new problems has been created by the war. It is, perhaps, less palatable, but just as true, to point out that all of the old pre-war problems are still with us and that most of them are still as far as ever from a practical solution.

Post-war forecasts disregard expenditures for the military and naval establishment and rest largely upon the prospective requirements of the civilian population. Most of the discussions ignore previous history and start off with the assumption of a new plateau of permanent prosperity. The present analysis suggests that it is only fair to the executive who is trying to guide his actions by an intelligent guess as to the future to point out that there appear to be several factors which have been overlooked and that unless these are correctly evaluated, no reasonable approach to this subject is possible.

Many forecasts of the continuation of the present high level of industrial activity are based on a so-called "pent-up demand," arising from the large increase in purchasing power of the wage-earning portion of the country, coupled with the inadequacy of the outlets through which this purchasing power can be dissipated. No contribution is foreseen by the income-frozen, tax-poor middle class which, in former years, produced most of the savings which alone made possible the great expansion of the country's productive capacity.

It cannot be sufficiently emphasized that the doctrine of "excess purchasing power" overlooks the important point that, at any time, effective purchasing power depends not only upon the existence of mass employment and full production but also upon *the prospect of its continuance*. The millions of workers and service men, if once unemployed when the war ends, will not draw on their savings (except as they cannot help themselves) to buy "deferred" things. They will purchase freely only if they have jobs and expect to continue to get their pay checks regularly. This is an objection which may be advanced against many of the surveys of prospective post-war demands which are based upon the present intentions of the people interviewed. Such intentions are only as of the present moment; when and if these persons are laid off, other intentions immediately present themselves. The same criticism may also be advanced in regard to the statements of various businesses that they expect to employ a definite number of people at some given future time. Such statements are usually predicated upon the most favorable conditions, and it would indeed require a rare degree of moral courage to say that, instead of employing men, lay-offs would be in order.

Pre-War Years Above Normal

The Federal Reserve Bulletin for January, 1944, showed the volume of production of war materials and civilian goods during the past five years. This indicated that the total production of civilian goods during the past three years has, in the aggregate, been as great as in any pre-war period of equal span in the history of the country. In tabular form, the Federal Reserve Board's index is as follows:

Index Numbers (Per cent of 1935-39 Physical Volume)

Year	*Total Prod'n*	*War Matl's*	*Civilian Goods*
1929	110	...	110
1932	58	...	58
1933	69	...	69
1934	75	...	75
1935	87	...	87
1936	103	...	103
1937	113	...	113
1938	89	...	89
1939	109	2	107
1940	125	6	119
1941	162	32	130
1942	199	107	92
1943	240	160	80

According to this table, the production of civilian goods during the three years 1941, 1942 and 1943 averaged 101. For the three years 1938, 1939 and 1940, immediately before the war, the average was 105; for the years 1937, 1938 and 1939 it was 103 and for the three years 1936, 1937 and 1938 the figure was 102.

"The outstanding fact," states the Federal Reserve Board in its February Bulletin, "is that the American economy has been able to produce far more than anyone supposed it could and that consequently so far it has met the challenge of the war without having to diminish aggregate civilian consumption below the 1939 level."

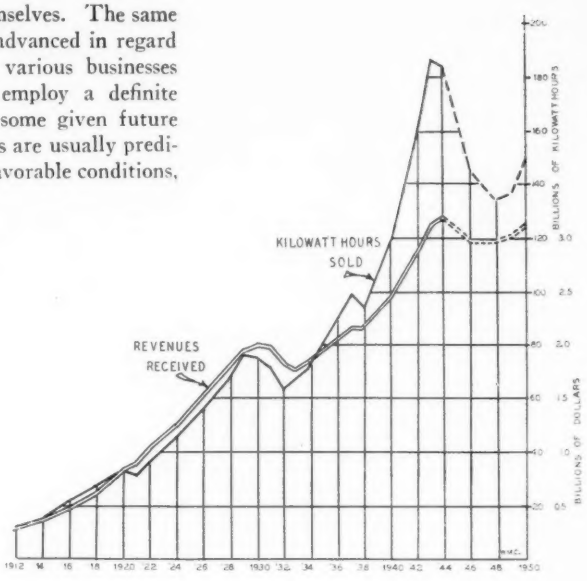
KILOWATT HOURS SOLD
REVENUES RECEIVED
BILLIONS OF KILOWATT HOURS
BILLIONS OF DOLLARS
1912 14 16 18 1920 22 24 26 28 1930 32 34 36 38 1940 42 44 46 48 1950

Fig. 2

Sales and Revenues of the Electric Light and Power Industry

On this point, it may be observed that the cessation of civilian production in 1942-43 was, in large measure, made possible by the obvious over-production of the three prior years. The sale of 64 billion kwhr of industrial power in 1941 for civilian purposes was the largest in the history of this country and was 26 per cent above the average of the representative years 1936-37-38.

As to the depleted inventories upon which much of the prospect for large production depends, it has been pointed out that, in addition to the Federal Government's stockpiles, inventories are already on the increase. In addition to this, retailers do not seem to be worrying so much about having *no* inventories, as they are about having the *wrong* inventories, which means that they interpret "pent-up demand," not as implying that the public will buy at random on a lavish scale, but rather that it will wait for acceptable peace-time commodities—*at the right price.*

Except for the more obvious items of durable consumer goods, it is open to question that there really is any great deficiency of demand which cannot readily be filled during the tapering off of war production. The suggestion is advanced that the early post-war years will therefore approximate the character and tempo of the years 1936-38 as far as the private companies are concerned. As far as the Federal power plants are con-

cerned, the question of over-capacity becomes, however, a more serious matter.

Supply More Important Than Demand

It used to be regarded as axiomatic that, over long periods of time, supply has more effect upon economic conditions than has demand. Apparently this has either been disregarded or else sacrificed to the narrow, short-term viewpoint where demand is the only factor that counts.

On this score, the over-production of war materials will have unusual significance and the liquidation of the Government's stockpiles of almost everything that enters into civilian life will be the dominating influence. Beyond this the disposition of government-financed war plants after they are no longer needed for their original purpose is one of the large post-war problems. These new facilities are of such magnitude and scope that, if they are substantially utilized in peace-time production, they will affect almost every phase of manufacturing activity.

Aluminum—A Political Metal

The report of the Bonneville Power Administration for the fiscal year 1943 states that 97 per cent of its direct sales are for war purposes and that "power produced at Grand Coulee was consumed chiefly by aluminum reduction industries . . . from this area came 30 per cent of the national output of this light metal."[a]

Similarly, "75 per cent of the power delivered from the TVA system went directly into the manufacture of war materials or into other war-time uses."[b] The total production of aluminum in 1943 has been stated to have been 920,000 tons which, in the chemical treatment of its ore and its subsequent electrolytic reduction to metal, may be said to have consumed 20,250,000,000 kwhr of electricity. Altogether, with other scattered plants on the lines of the public power enterprises, it is possible that nearly half of the total output of aluminum last year was produced by power from public plants. This, alone, represented a production which was three times the country's total in the pre-war year 1939 which, itself, represented an all-time record.

While advocates of the use of aluminum maintain that it will be able to supplant a part of the enormous use of steel in this country and a part of other metals, it is reasonable to assume that this supplanting process will be slow. It will probably involve a transition period of several years during which time it seems probable that there will not only be a substantial excess of generating capacity in these areas, but also that, by a strange irony of fate, these government projects will be in competition with each other for what business there is.

After 1947

The foregoing discussion represents a belief that for the electric utility companies generally there will be no sharp disruption at the close of the war, but rather a gradual shift from a business dominated by war expenditures to a civilian economy. It is clear that as soon as materials and manpower are available, the companies and the electrical equipment manufacturers will resume their vigorous efforts to enlarge the residential, farm and retail commercial uses of electricity. Tables 1 and 2 are predicated on that obvious assumption. There is a lag, however, between the time when the sales promotion is undertaken and the time when its full effect in increased sales becomes obvious, and the years 1948, 1949 and 1950 are expected to show a considerably greater expansion in the retail use of electricity.

New developments in materials, machines and particularly in production methods have continued to make their appearance throughout the war period. Following the end of the war, it may be expected to take two to four years to bring into full play the application to peace-time production of that which is still new in manufacturing, and the years following 1948 should then see expanding industrial power sales. The electric utilities companies have devoted their lifetime in creating, through commercial exploitation, power demands which were satisfied as fast as they could be coaxed to grow, and they may be expected again to demonstrate, as they have during the present war and many times before, that they can plan and execute the provision of dependable and efficient power facilities to supply any market that may make its appearance.

APPENDIX

Assumptions as to Sales of Electricity in 1947

The estimate for sales of electricity in 1947 is based upon the following assumptions:

1. The curve of expenditures for war purposes rests upon the assumption that fighting in Europe will cease before the end of 1944.
2. That domestic and rural service will increase from 1943 to 1947 at the same rate that prevailed from 1939 to 1943. This will allow for the gradual satisfaction of the so-called "pent-up demand."
3. That small commercial (retail service) will increase at one-half the rate that prevailed from 1939 to 1943. This will allow for the gradual reopening of stores, etc., that were closed on account of the war and for the resumption of production on many small civilian items.
4. That traction, street lighting, etc., will remain substantially the same as in 1941.
5. That industrial power sales will show a steady decline until the year 1948 approximates the average of 1936-37-38. This brings the figure for 1947 to 58 billion kwhr, the same as the sales in 1939 but nevertheless 50 per cent below those of 1943.

The sum total of these forecasts appear as Table 1, which estimates total sales in 1947 as compared with 1943. Kwhr sold indicate a decrease of 25 per cent but revenues show a drop of only $125,000,000 or 4 per cent.

Capacity Factors Indicate No Excess for Private Utilities

As reliable measure of the degree of idle capacity is the ratio of kwhr sold per kw of plant. This is detailed in Table 3 which shows these figures year by years since 1936. The estimates for the year 1947 are arrived at by dividing the estimated sales by the total capacities installed according to present plans for new construction.

TABLE 3—GENERATING CAPACITY AND SALES TO ULTIMATE CONSUMERS

Year	Capacity (million kw) On Dec. 31	Capacity (million kw) Av'g of Year	Kilowatthours Sold Billions	Kilowatthours Sold Per Kw Capacity
	Companies			
1935	31.6	....	....	....
1936	31.7	31.65	83.7	2645
1937	31.9	31.8	91.9	2890
1938	33.0	32.45	85.7	2640
1939	33.7	33.35	96.8	2900
1940	34.2	33.95	107.2	3160
1941	35.8	35.0	125.3	3580
1942	37.4	36.6	140.4	3835
1943	39.1	38.25	161.5	4220
1947	39.5	39.4	121.5	3075

[a] Annual Report, Secretary of the Interior for fiscal year 1943, p. 67.
[b] Annual Report, TVA, for fiscal year 1943, p. 33.

E. E. I. Depreciation Principles Report Adopted

The following report was adopted February 1st by the Board of Trustees and the Operating Committee of the Institute. It was presented before the Depreciation Committee of the National Association of Railroad and Utility Commissioners at a hearing held in New York Feb. 2-4, 1944, together with the "Comments by EEI Depreciation Committee on 1943 Report of NARUC Committee on Depreciation," appearing on page 70. Both statements deal with the extensive report of the NARUC Committee submitted at last year's convention of the NARUC, held at Chicago, Sept. 14, 1943, and now under consideration by the Commissioners.

At the hearing held in New York, representatives of the Independent Telephone Association, Bell Telephone System, American Institute of Accountants, American Gas Association and other interests were heard, in addition to the Edison Electric Institute.

THIS report has confined its recommendations to basic principles, believing that the variations in conditions, practices and past corporate history among hundreds of utility companies and the various regulatory authorities and laws in forty-eight states are so great that it would be unwise and impractical to attempt to arrive at specific formulae of universal application with respect to the determination of provisions for depreciation.

The following statement of conclusions is accompanied with comments on points of fundamental difference with the conclusions of the 1943 report of the Committee on Depreciation of the National Association of Railroad and Utilities Commissioners:

1. *Depreciation.* The definition of depreciation believed to be sound and adequate is quoted from the decision of the Supreme Court in the Lindheimer case as follows:

"Broadly speaking, depreciation is the loss, not restored by current maintenance, which is due to all the factors causing the ultimate retirement of the property. These factors embrace wear and tear, decay, inadequacy and obsolescence. Annual depreciation is the loss which takes place in a year."

2. *Depreciation Accounting.* This is the process of recording on the books of account in a rational and systematic manner the provision made for recoupment of the loss caused by depreciation, as above defined.

3. *Provision for Depreciation.* The charge made against revenue is a part of the cost of furnishing service, to provide for the recoupment of the loss caused by depreciation as above defined.

4. *Method of Determining Provision for Depreciation.* The use of the service-life process as the controlling basis for determining provision for depreciation is not approved, but it is recognized that such use may be helpful with respect to units or classes of property for which applicable and reliable service-life records are available. As pointed out in the NARUC report, a recent study covering a large amount of utility property, both gas and electric, showed that only 18 per cent of property retirements was caused by physical conditions as contrasted with 82 per cent due to inadequacy, obsolescence and other causes. There are, in fact, other important factors, outside and beyond the service-life concept, which must be allowed for in order to provide properly for depreciation for individual utility properties operating under widely varying conditions.

There is a preferable procedure for determining reserves and their maintenance which is set forth in the following Sections 5 and 6.

5. *Size of Reserve.* The size of an adequate depreciation reserve should be determined by each company in consultation with the appropriate regulatory authority. Such determination should be based on a study of all pertinent facts, including, among other things, the history of retirement costs, accumulated reserves and their credits over a period of years sufficient to establish trends therein, the character, age and physical condition of the property, its past and prospective rate of growth, economic conditions in the area served, technical and economic developments affecting the continued use of existing facilities, liability of loss from storms or other casualties, and requirements imposed by regulatory authorities or courts.

Having established the size of the reserve, the factors on which it is based should be subject to review at such intervals as the regulatory authority may direct, and to such revision as experience may indicate to be necessary or desirable.

6. *Annual Credits to the Reserve.* The annual credits to the depreciation reserve referred to in Section 3 should be those necessary to maintain it at the amount determined from time to time by company and appropriate regulatory authority, giving due consideration to (1) charges to the reserve for retirements and (2) the amounts which should be provided because of increases in property. In considering these factors, due weight should be given to the company's records of growth and retirements over a period of sufficient length to constitute an adequate experience base.

If an existing depreciation reserve built up in the past in good faith is below the level fixed by appropriate regulatory authority, after consultation as above, the necessary adjustment should be made gradually over such period of years as will not endanger the credit of the company affected or unduly increase the cost of service.

If an existing depreciation reserve is in excess of the amount found adequate by the appropriate regulatory authority, after consultation as above, such excess may properly be set aside in a special reserve subject to such use as the regulatory authority may direct.

While this report has confined its recommendations to basic principles, it is believed that within certain limits mathematical processes can be developed, at least for properties of conventional character, which may be used in connection with the records of companies in determining both reserve size and annual credits thereto in consultation with the appropriate regulatory authority as above provided.

7. *Depreciation Reserve in Rate Cases.* The sole purpose of the depreciation reserve is to provide for the retirement of property at its cost less salvage; hence the reserve accumulated from operating revenues for that purpose can be permanently diverted to no other use.

For the same basic reason the assumptions are unacceptable that the reserve funds which the company is permitted to collect in order to maintain the integrity of the investment for the service rendered represent either a return of principal to the investor or depreciation which has in fact taken place as of any given date.

This, therefore, also makes unacceptable those conclusions in the NARUC report which are based on these assumptions, particularly conclusions No. 39 and No. 40. (Quoted on page 73). However, it is realized that these sections are an endeavor to meet the equities of those situations where funds represented by the reserve created for the specific pur-

(*Continued on page 73*)

Comments by EEI Depreciation Committee on 1943 Report of NARUC Committee on Depreciation

The following comments on the 1943 Report of the Committee on Depreciation of the National Association of Railroad and Utilities Commissioners are submitted by the Depreciation Committee of the Edison Electric Institute. The views expressed herein reflect the collective opinion of many executives in the industry and of the committee membership representing a broad cross section of the industry, though they of course cannot commit the industry as a whole, nor the member companies of the Institute. For convenience, the bodies represented by the NARUC Committee on Depreciation are sometimes referred to as "Commissions," while the utility representatives are sometimes called "Industry."

The NARUC Report is a comprehensive, well written study, and Industry representatives are in substantial agreement with much that is in the report. As to a number of points, there is some question or disagreement, concerned principally with technical discussions of Depreciation Methods and Service Life Estimates, which could most effectively be disposed of by informal discussions between technical representatives of the NARUC and EEI committees, and as to a few major conclusions there is definite disagreement.

In the interest of brevity, no attempt is made to comment on the report chapter by chapter; but attention is first given to the few major points of disagreement, and this is followed by a discussion of Industry's viewpoints as to constructive solutions of the depreciation problems.

MAJOR POINTS AT ISSUE

THERE are at least three major conclusions which seem to be implicit in the NARUC Report, which Industry believes to be in error and in serious need of reconsideration. These are:[1]

(1) The conclusion that annual and accrued depreciation can be determined by calculations based on age and life studies and estimates;

(2) The conclusion that service life calculations of annual and accrued depreciation provide a reliable, valid measure by which to make financial readjustments to surplus and capital;

(3) The conclusion that service life computations of depreciation, preferably on a straight line basis, should normally be controlling in the treatment of depreciation for rate making purposes.

Disagreement with these conclusions, as discussed more fully below, rests on two grounds:

First, because theoretical age-life computations of the depreciation reserve do not give an objective measure either of the accrued depreciation or of the amount that should have been accumulated in the reserve; and

Second, because the use of theoretical computations as the controlling standard would represent retroactive regulation, which is unfair, contrary to established principles of equity, and inconsistent with respect to controlling decisions of the past in rate making and other matters, in which Commissions have had a part.

Depreciation Computations Not Factual

Service life calculations of depreciation are necessarily based on judgments, assumptions and estimates; they must deal primarily with the uncertain *future* life of existing plant, rather than the past history of plant already retired; they necessarily involve theoretical considerations and mathematical assumptions which do not accord with the facts. As to many items of existing property, there is no satisfactory measure of probable future life in the experience of the past because of many changing conditions, nor will such measure be available until retirement is brought into the foreseeable future, by force of circumstances and plans which will develop in the future. In the meantime service-life must necessarily be largely a matter of conjecture, and age-life computations of depreciation accruals and reserves must likewise be conjectural.

Support for these observations is found in field studies of actual property experience, of which a few illustrative examples are included in Appendix B hereof.* As pointed out there, the reliance on statistical age-life studies of depreciation rests on a supposed similarity between human mortality as applied to life insurance and plant mortality as applied to depreciation. But these examples show quite clearly that such similarity does not in fact exist; that plant mortality does not have consistency or uniformity from one generation to the next, which is fundamental to the reliable use of age-life methods of computing depreciation. Experience shows wide variations in life estimates as between one date and later dates, wide variations in the rate of retirement for a given age, differences in the "dispersal pattern" of retirements, and erratic changes in the factors causing retirements—all of which have a major effect on age-life computations.

Depreciation in the property does not proceed with the regularity exemplified by the mathematical computations, and in the actual case such regularity would not be achieved even if a formula method were consistently applied. Revisions in the basic data and life estimates, necessitated from time to time by changing conditions, would in fact introduce the very types of irregularities which the mathematical approach seeks to obviate. Each time there is a new set of estimates, it changes not only the annual depreciation figure but also the reserve computation, and this would require an adjustment in the book reserve each time a new set of computations is made if the computations were accepted as *the* valid standard. Thus, while age-life computations may be a useful tool for translating judgments and estimates into dollar terms as a guide to fixing the annual depreciation accrual, they do not have the same validity in judging accrued depreciation or the depreciation reserve.

The NARUC report recognizes at various points[2] that age-life data necessarily involve many judgments, assumptions and estimates, and that theoretical calculations of the depreciation accrual or the reserve must also have the frailities inherent in the data and in the assumptions and mathematical theories on which the calculations are based. However, from this initial point, the report moves on to the final conclusion that such theoretical determinations are not only a proper standard, but that ordinarily they are the *only* proper standard, for the treatment of depreciation matters. There is no apparent bridge to this great gap between the initial recognition of frailities, and the "authenticity" that is attributed to the final calculations.

Yet this gap is of major significance. For it is clear that theoretical computations of depreciation do not provide a *factual, objective* standard by which to make an arbitrary judgment as to the adequacy or inadequacy of either the depreciation accrual or the depreciation

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[1] See Appendix A to this memorandum, for NARUC Statements in which these conclusions are implicit.

* Copies of Appendix B may be obtained from the Edison Electric Institute.

[2] See, for example, the following points in the NARUC report:

Summary—items 28 and 29 (quoted in Appendix A to this memorandum)
Chapter V—first two paragraphs under "Conclusion" (pages 86-7)
Chapter VI—the opening paragraphs, particularly in the third and the fifth to ninth paragraphs (pages 95-7)
Chapter VII—opening paragraph (page 112).

reserve. Such determinations may be useful as a guide to judgment as to the reasonable and proper provisions for depreciation; but assuredly they should not be the sole or primary guide.

Depreciation Provisions Are Tentative

While the impact of depreciation is certain, the period over which it will occur is most uncertain. Therefore, however the proper depreciation charge is determined, it is necessarily a *tentative* provision for meeting the cost of depreciation, and the book reserve resulting from such charges must likewise be tentative.

The NARUC report does not seem to recognize this fact when it urges (in the Summary) that

"29. Current charges for depreciation expense should be based upon the best possible estimates of the amount properly applicable to the period covered by an income statement, *without modification for excessive or deficient charges in the past.*" (Italics added.)

and when it urges that

"30. The depreciation *reserve should not be readjusted gradually through modification of the annual depreciation rates* when the difference between the book reserve and the proper reserve is substantial. . . ." (Italics added.)

and that

"31. In principle any necessary correction of depreciation reserves should be made through surplus or a special section of the income account. . . ."

These conclusions seem to rest upon the unsupported conclusion that age-life computations provide a valid measure of depreciation accruing in a period and accrued at the end of the period—a conclusion which is not borne out by the facts, as noted in the preceding comments.

Because of these considerations, the sound approach in fixing the annual depreciation accrual is to make the best possible judgment as to the proper provision in the light of all known conditions, *including* whatever modifications are reasonably necessary to care for what may currently appear to be excesses or deficiencies in past accruals. The book reserve should likewise be judged, *not* in terms of fictitiously precise computations of a reserve requirement, but again from consideration of all the known factors affecting the situation.

Application of Depreciation Computations

The use of theoretical depreciation computations as the controlling standard, as recommended by the NARUC report, involves the following applications:

1. In accounting, the books of account would ordinarily be adjusted to conform with whatever theoretical computations are selected as "proper."

2. In financing or reorganization cases, the adjusted reserve as above, or an equivalent theoretical reserve computation, would be used in determining the amount of securities permitted to be issued or to remain outstanding.

3. In rate making proceedings, the theoretically computed reserve would be used as the measure of depreciation in establishing a depreciated rate base; and a corresponding annual accrual on an age-life basis would be used in determining the allowed return.

Each of these applications has grave implications, where the computed reserve is greater than the book reserve accumulated out of earnings. For in all of these cases, the use of the theoretical standard would have the effect of wiping out capital investment, or the earnings on the investment, with no recourse by the investor. The accounting adjustment, when made at once and not spread over a future period, requires transfers from surplus, or reductions of capital to provide the necessary amount where surplus is insufficient; but in either event it reduces the amount of investors' funds which are recognized thereafter and represents a first step in the expropriation of these funds in the amount of the adjustment. In the financing or reorganization case, securities are arbitrarily declared worthless by whatever amount the computed reserve exceeds the book reserve. And in the rate case, the permitted return is arbitrarily reduced, thereby depressing the value of all equity securities.

These are serious results which would endanger the continued welfare of the privately owned electric utility industry, and they are a heavy responsibility on regulatory bodies which should not be passed over lightly. Industry believes that these matters are not dealt with sufficiently or properly in the NARUC committee's 1943 report and a reconsideration of these phases is urged.

Retroactive Regulation is Unjust

The arbitrary use of the computed reserve-requirement in these matters represents a retroactive application of present theories, which disregard the facts or controlling influences of the past. There is serious question as to the justice or legal propriety of using such retroactive standards, quite aside from the question of their reliability. The accumulations of the past have been made in accordance with standards and practices which were accepted by regulatory authorities and the industry, and these depreciation concepts were also recognized in the establishment of rates for consumers and in the investment of funds by the public. Present reserves thus represent largely the amounts accumulated under the influence of these factors, and at the very least they are therefore entitled to considerable weight as prima facie evidence of the reasonableness of past provisions.

Further considerations which bear on this question are found in Chapter X of the NARUC report. This discussion cites a number of court and commission rate case decisions involving depreciation, in which the companies' claims for annual depreciation expense were reduced in rate making proceedings to amounts considered appropriate by the court or commission. Yet the present application of the reserve-requirement theory would now penalize companies on the basis of present theoretical computations, even though they had not in the past been permitted to earn the larger depreciation provisions indicated by these present computations. This chapter also cites cases in which accrued depreciation was determined and approved by the courts by the inspection and study of the properties (that is, by the "observation" methods on which the NARUC report looks with disfavor); yet the report now seems to advocate a complete denial of these decisions of the past.

If commissions at this point disregard these controlling influences of the past, and substitute the arbitrary determinations based on assumptions and estimates, they in effect would admit that they erred in the past, but would now be forcing the utility companies to shoulder the entire burden due to these admitted errors.

General Observations

The "Conclusion" in Chapter V of the NARUC report (pages 86-7) contains some significant observations, bearing on both the reliability and equity of theoretical computations, which seem to be lost sight of in the Summary. These observations follow:

"The general explanation of methods at the beginning of this chapter demonstrates that many methods will provide reserves which are adequate for all retirements and which will be wiped out by the last retirement. *On the basis of this criterion they may be said to be mathematically correct. Furthermore, it can be shown that under various methods the combined depreciation and return when reduced to terms of present worth are identical.* Of course the same method and procedure must be used for calculating the accrued decreciation that is used in determining the annual depreciation rate. How-

ever, the mathematical validity of a method is not the sole criterion for its practicability in every day use. *The mathematical validity of the method does not determine its consistency with economic forces, nor its equity as between owners and customers and between various groups of customers.* Some mathematically correct methods result in high annual charges in the last years of the life of property when its efficiency may be low and other charges high. Other mathematically correct methods load operating costs so heavily in the early years of life of property that the result may be out of all proportion to the concurrent depreciation cost actually incurred. Other mathematically correct methods required such detailed records and elaborate analyses and calculations that the high accounting costs outweigh any theoretical advantages that may be claimed for them." (Italics added.)

The point is made that there are various methods for computing the reserves, producing various results, all of which may be said to be mathematically valid or correct. This statement appears correct, but it naturally raises the query "How can all of them be right?" The report also observes that "the mathematical validity of the method does not determine its consistency with economic forces, nor its equity as between owners and customers and between various groups of customers." Taken together, these statements point to the conclusion that if a number of methods have mathematical validity (as they do), not all of them—*and perhaps no one of them*—can be "right," and that no one of them can be plucked out to serve as a standard for saying that another one is wrong.

This is particularly so since the question of "equity as between owners and customers and between various groups of customers" is also involved. Thus, if a company has followed some method providing less than a straight line accumulation in the past, can it properly be claimed that provisions were adequate because they now fall short of straight line computations of the reserve? If rates were generally established on some other basis (as they were), and if the amounts recouped from customers were accordingly lower (as they also were), can it be concluded that it is consistent or equitable to now apply an arbitrary test which may have little or no relation to what was generally accepted in court and commission decisions of the past?

Conclusion 40 seems to reach the primary conclusion that, in principle, it is ordinarily proper to use such arbitrary standards, when it says (page XIX):

"In fixing public utility rates adequate depreciation expense should be allowed according to the service life basis and, in principle, the reserve requirement determined on the same basis should be deducted in determining the rate base."

But this conclusion is opposed to the statement quoted above, namely that "the mathematical validity of the method does not determine its consistency . . . nor its equity . . ."

Likewise there seems to be an irrelevant and illogical conclusion in the sixth paragraph from the end of Chapter X, which says (page 169):

". . . In this *continuing process*, depreciation expense should be computed on a basis of service life, capacity, or utility, and actual depreciation should be deducted on the same basis. This is but another way of saying a *proper reserve* for depreciation *should be deducted* from cost, or a corresponding reserve deducted from reproduction cost, *in computing the rate base*." (Italics added.)

The fallacy lies in the fact that in the "continuing process" of regulation "proper" depreciation (as now interpreted and understood) may not have been the basis of past dealings on rate matters. The same point affects the conclusion of the next paragraph which avers that deduction of the reserve or its equivalent "obviates all harmful inconsistencies." In this reference to "inconsistencies," the NARUC report overlooks that an equally important "consistency" is consistency with the past, with respect to matters affecting rates and the amounts actually collected thereunder and reflected on the books.

A final observation relates to the conflicting conclusions in the NARUC report with reference to reserve adjustments. Thus, there is the unsupported statement that "it is desirable to adjust depreciation reserves . . ." But this point is open to serious question, for if theoretical computations do not have the validity of factual determinations, what objective standard is there by which to make such adjustments? Doesn't it simply boil down to the substitution of one more or less arbitrary judgment for another judgment? For the report itself recognizes that (page 115):

"Great caution should be exercised in transferring to surplus any amounts by which reserves are found to be excessive. *It should be remembered that the determination is necessarily an estimate.*" (Italics added.)

Yet when a reserve deficiency is indicated by the same process, "it is desirable to adjust depreciation reserves by charges to surplus or to a special section of the income account." (page 115)

It thus appears that the adjustment principle is intended to operate in a kind of "one way street," with great reliance being placed on the theoretical computed reserve when a deficiency seems to be indicated, but with full recognition of the infirmities when excesses are indicated. However, this recognition that "the determination is necessarily an estimate" is precisely the core of the matter, the unreliability of such determinations being one of the two major criticisms, and the unfairness of their use being the other major objection.

APPENDIX A—NARUC STATEMENTS BEARING ON MAJOR POINTS AT ISSUE

The three major conclusions with which Industry disagrees are embodied in the following numbered paragraphs of the NARUC Report Summary (italics supplied):

Conclusion One: That annual and accrued depreciation can be determined by calculations based on age and life studies and estimates, is implicit in the following:

"5. Depreciation accounting is the process of charging the book cost of depreciable property to operations over its life.

"7. In the past several methods have been employed to account for the consumption of the service or economic life of plant assets, including the retirement, replacement, appraisal, arbitrary writedown, retirement reserve, and depreciation methods. Only the depreciation method survives in general use.

"8. There are two interrelated aspects of depreciation: annual expense and accrued depreciation. Annual expense is shown in the income statement; accrued depreciation is recorded in the depreciation reserve, a balance sheet account.

"9. Depreciation is the using up of the economic or service life of an asset regardless of the specific factor which may ultimately cause the asset to be retired. It is the exhaustion of service life, not the particular cause of retirement, that is important.

"12. The depreciation reserve measured that part of the cost of plant still in service which has been written off, usually as an operating expense. *If the depreciation reserve has been properly determined, it measures the accrued depreciation.* The depreciation reserve should preferably be shown on the asset side of the balance sheet as a deduction from depreciable plant.

"26. The straight-line method is generally recommended for public utility accounting and financial purposes and also for the computation of both depreciation expenses and accrued depreciation for purposes of rate making.

"28. The determination of depreciation rates according to any reasonable procedure involves the use of judgment in the application of methods. Statistical data drawn from property experience and applied with judgment based on knowledge of the property should be given much greater weight than general judgments based principally on observation of the property."

Conclusion Two: That theoretical computations of annual and accrued depreciation, on an age-life basis, provide a suitable measure for fixing depreciation accounting provisions and for making financial readjustments, is implicit in the following:

"29. Current charges for depreciation expense should be based upon the best possible estimates of the amount properly applicable to the period covered by an income statement, without modification for excessive or deficient charges in the past.

"30. The depreciative reserve should not

be readjusted gradually through modification of the annual depreciation rates when the difference between the book reserve and the proper reserve is substantial. When the difference is not substantial it is satisfactory to spread the remaining net cost of the properties over their remaining lives.

"31. In principle any necessary correction of depreciation reserves should be made through surplus or a special section of the income account. However, the adjustment of inadequate depreciation reserves, while sound in theory, presents many practical difficulties. Where such deficiencies are serious, it is desirable to make every effort to adjust them, although it is recognized that the application of a uniform rule without regard to what is equitable and feasible under the circumstances of individual cases might cause injury to security holders out of proportion to the long-range benefits. Therefore, it is concluded that the objective of correcting inadequate reserves should be approached with appropriate consideration of the practical effects of alternative courses of action.

"43. Management and public accountants have a responsibility to indicate in financial statements the proper depreciation expense and the reserve requirement, according to their best information after appropriate study, in those instances where the book figures are inadequate or excessive in a material amount."

These statements, coupled with the items quoted under conclusion one, can mean only one thing, namely, that primary reliance in all accounting and financial matters is to be placed on the theoretical age-life computations of depreciation.

Conclusion Three: That theoretical computations of annual and accrued depreciation, preferably on a straight line basis, should normally be controlling in the treatment of depreciation of rate making purposes, is implicit in the following:

"37. The same factors which cause annual depreciation expense also cause accrued depreciation. Accordingly, the same principles should be applied in determining annual depreciation expense and in determining accrued depreciation.

"38. So-called observed depreciation is not accrued or existing depreciation. Depreciation is not visually observable; only the physical effects of some of the forces which operate to cause retirement can be observed.

"39. A properly computed depreciation reserve is the best measure of accrued or existing depreciation, since such reserve reflects that part of the cost of the property in service which relates to the exhausted or expired economic or service life.

"40. In fixing public utility rates adequate depreciation expense should be allowed according to the service life basis, and, in principle, the reserve requirement determined on the same basis should be deducted in determining the rate base. There are cases, however, where equity requires the deduction of the book depreciation reserve, even though it differs materially from the reserve requirement. The determination as to when this condition exists involves, among other things, consideration of the history of regulatory requirements in the jurisdiction and the experience and practices of the company. In other words, individual situations should be dealt with by the commission having jurisdiction in accordance with the facts in each case.

"41. The use of the straight-line method in determining both depreciation expense and accrued depreciation is generally recommended for rate-making purposes."

JOINT MEETING OF ELECTRIC & GAS ACCOUNTANTS

April 26 and 27 at Cleveland

The electric and gas accountants will hold their annual spring conference at the Cleveland Hotel, Cleveland, Ohio, on Wednesday and Thursday, April 26 and 27, 1944. This will be the fifth joint meeting of the accountants of both industries.

These spring conferences have been of outstanding importance in the past and are held soon enough after the year-end rush to permit of working out the problems arising from new legislation and changing conditions resulting from the war, and of planning for the current year.

Personnel problems will probably be the theme of the meeting, with regulatory matters following closely.

A liberal sprinkling of outside speakers is planned for the general sessions. Meetings of the Customers' Accounting and General Accounting groups will provide plenty of discussion on current problems and post war planning. Committee meetings will be scheduled for developing activities for the near future.

Program committee representatives will arrange the speaking schedule and the allotment of time for the various group meetings. The program will be published in the next issue of the BULLETIN and will also be mailed to industry representatives shortly.

The Accounting Executive Committee, the governing body for the EEI group will have its annual dinner during the period of the conference.

EEI Depreciation Principles Adopted

(*Continued from page 69*)

pose of providing for retirement of property, are, pending appropriate charges, used for other purposes. In consequence, the principle is accepted as sound that in those situations the funds accumulated for the purpose of the reserve should, when temporarily used for other purposes, be augmented by interest credits consistent with the savings effected by their use in lieu of other corporate borrowing.

* * *

Conclusion No. 39—"A property computed depreciation reserve is the best measure of accrued or existing depreciation, since such reserve reflects that part of the cost of the property in service which relates to the exhausted or expired economic or service life."

Conclusion No. 40—"In fixing public utility rates adequate depreciation expense should be allowed according to the service life basis and, in principle, the reserve requirement determined on the same basis should be deducted in determining the rate base. There are cases, however, where equity requires the deduction of the book depreciation reserve, even though it differs materially from the reserve requirement. The determination as to when this condition exists, involves, among other things, consideration of the history of regulatory requirements in the jurisdiction and the experience and practices of the company. In other words, individual situations should be dealt with by the commission having jurisdiction in accordance with the facts in each case."

Correction on Tax and Revenue Comparisons

IN the series of figures in Table II, showing gross revenues and taxes of private utility companies, in the article "TVA Taxes Going Down; Private Utility Taxes Coming Up," appearing on page 44 of the February 1944 issue of the EEI BULLETIN, three zeros were inadvertently dropped from each of the figures listed, thereby giving an incorrect comparison with the TVA figures listed in Table I. Table II, corrected, follows, together with Table I, for correct comparison.

TABLE II — ALL PRIVATE UTILITIES OF THE U. S.

12 Months Ended June 30:	*1940*	*1941*	*1942*	*1943*
Gross Revenues	$2,213,000,000	$2,372,000,000	$2,539,000,000	$2,713,000,000
Taxes	378,000,000	462,000,000	575,000,000	670,000,000
Taxes as Per Cent of Revenue	17.1%	19.5%	22.6%	24.7%

TABLE I — TVA MUNICIPALITIES AND COOPERATIVES

Fiscal Year June 30:	*1940*	*1941*	*1942*	*1943*
Gross Revenues	$21,624,008	$27,371,904	$31,123,129	$34,670,332
Taxes and Tax Equivalents	1,638,389	1,788,743	1,843,576	1,957,614
Taxes as Per Cent of Revenue	7.58%	6.53%	5.93%	5.64%

How Edison Discovered Keystone of Electronics

By Dr. O. H. Caldwell

From an address before the Edison Pioneers Celebration of the great inventor's 97th birthday, New York, Feb. 11, 1944

ONE of Thomas A. Edison's most fruitful discoveries grew out of his keen detection of trifles that his assistants overlooked. This was his discovery, 60 years ago, of the famous Edison Effect, the flow of electrons in a vacuum, which underlies all electronic phenomena as we know that vast new science today.

After Mr. Edison had invented his incandescent lamp and had gotten his new electric lighting system into operation, trouble began to develop caused by the mysterious breaking of the filaments in the lamps. Invariably these filaments would break off near one end, where attached to the lead-in wires. Finally the problem was brought to the Chief himself. After a little scrutiny he noticed something which had been overlooked by all his assistants—that the filaments always broke at the positive end.

After confirming experiments, Mr. Edison reached the revolutionary conclusion that some kind of "particles" were coming from the whole length of the hot filament and were bombarding the positive end of the filament, breaking it down. He further reasoned that these "electrical particles" must be electrically negative in order to be attracted by the positive end of the filament. Also he observed the blackening and sharp "electron shadows" inside the globe, which others had noted.

Goaded by the business necessity of finding what was causing his filaments to break and his lamps to fail prematurely, Edison then carried on the experiment of inserting an extra wire or "plate" inside the lamp, which confirmed his electron "emission and bombardment" theory —though of course in 1883 he did not yet use the word "electron."

It was Edison himself who made the first industrial application of electronic action. He used it to solve a problem, just as engineers everywhere today are using electronics to solve difficulties. For in the early Eighties, as the lighting load was turned off, the old-fashioned generators gave trouble from increased voltage. Edison noted, however, that even a slightly increased voltage greatly increased the flow of electrons in an Edison Effect lamp fed from the generator circuit. So he applied this electron flow to actuate a galvanometer which in turn relayed a reduction in field excitation and so kept the generator voltage more nearly constant.

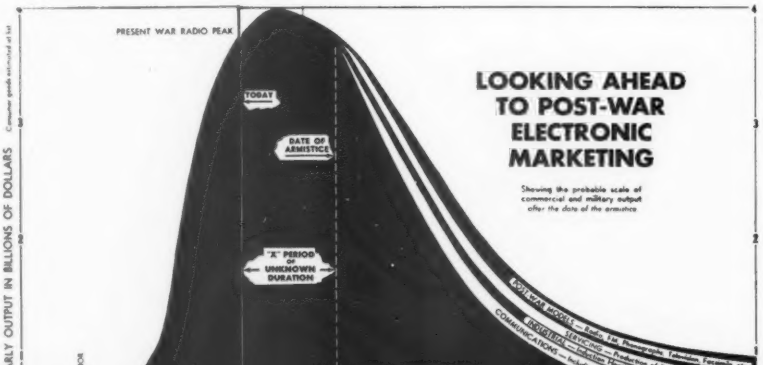
The original Edison Effect of 1883 was a faint phenomenon, apparently of little commercial value. But now, 60 years later, we find the annual output of equipment based on this phenomenon reaching the staggering total of four billion dollars—and still going up. Of course, the majority of this is now going for radio and radar in war equipment. But post-war we can foresee many peacetime applications of electronic action—Edison Effect action, if you prefer. Industry, business, science, agriculture, medicine, surgery, communication, the graphic arts, transportation, crime detection, the home, and everyday life—are all finding new and invaluable uses of electronic tubes and electronic principles.

That the resulting 110-volt radio tube of 1883 closely paralleled modern diodes was recently demonstrated over a national network, when, using in the modern circuit a replica of Edison's early two-element lamp or tube, Edison's favorite melody "I'll Take You Home Again, Kathleen" was broadcast.

How close Mr. Edison himself came to originating wireless communication is but little appreciated. As far back as 1875 Edison discovered and demonstrated the transmission of electrical impulses through the ether, that is without a return wire to make a complete metallic circuit. These were his "etheric force" experiments which called forth a great deal of discussion at the time and which were exhibited at the Paris Exposition of 1881 where they were viewed by many of the leading scientists of the day. The "sending" apparatus was a buzzer with one terminal grounded and the detector was a tiny spark gap enclosed in a black box, much as Hertz used years later.

In 1885 Mr. Edison applied for a patent which was granted in 1891, for means for transmitting signals electrically without connecting wires. This patent shows the use of high masts carrying condenser surfaces for spreading abroad the electrical impulses, and even shows two vessels equipped with the equivalent of modern antennas on their masts.

Thus Mr. Edison had almost within his grasp all the elements of a wireless system. He had the high-frequency currents, the elevated masts, and the detecting apparatus. It neeeded only the coordination of these elements to achieve practical results. But Mr. Edison was preoccupied with the difficult problems connected with his lighting and power system and so was obliged to leave the promising fields of electronic and radio research and development to others. However, his fundamental discovery, the Edison Effect, though it lay dormant and unused for 20 years, was not forgotten. Today we are gathering the fruits of Edison's labors in all the manifold applications of the science of electronics.


LOOKING AHEAD TO POST-WAR ELECTRONIC MARKETING
Showing the probable scale of commercial and military output after the date of the armistice
PRESENT WAR RADIO PEAK
TODAY
DATE OF ARMISTICE
"X" PERIOD OF UNKNOWN DURATION
PRODUCTION OF MILITARY RADIO AND ELECTRONIC EQUIPMENT
MILITARY MAINTENANCE AND DEVELOPMENT PROGRAM INCLUDING LEND-LEASE AND REPLACEMENTS FOR CIVIL DEPARTMENTS OF THE GOVERNMENT
PEARL HARBOR
YEARLY OUTPUT IN BILLIONS OF DOLLARS
JAN. '42
JAN. '43
DATE OF ARMISTICE ?
1 YEAR FROM ARMISTICE
2 YEARS FROM ARMISTICE

Outline for Distribution Planning

Programs for T. & D. Committee proposed to prepare for post-war. Extended viewpoint suggested in the transition

By Frank Sanford

Chairman, Transmission and Distribution Committee, EEI

Presented at T. & D. Committee meeting, Cincinnati, O., Feb. 14, 1944

DISCUSSIONS and papers at Transmission and Distribution Committee meetings reflect the trend of thinking in the industry. Programs in general are built around subjects receiving attention of the individual company members, and are designed to assist each company by providing a forum for helpful ideas. Our Committee is of direct benefit to every member because each of us can take back to his own organization the combination of information, experiences, and suggestions that our exchange affords. Each of us contributes by reporting the results of specialized studies and operating experiences.

By its nature, the activity of any committee such as ours should be at all times abreast of, or a little ahead of, the general problems of its members. We should be flexible enough in our organization and program planning to permit such changes as are needed to be most useful in our industry. We have been most fortunate in this respect. Our past chairmen and sponsors have carefully avoided a rigid plan and set of standing committees. Special groups have been appointed for specified projects. Several have needed to continue during a number of years while others could gather data, formulate a report or proposal, and disband.

A discussion of policies is pertinent at this time because the past two years have brought sharp revisions in our normal activities. We have been forced to some drastic changes in operation methods in our business of distribution. We can expect further changes either back to pre-war or into some new channels in the several year period after the war is over.

One of the broad policies accelerated by the war is that of close study of new methods. Committee meetings for exchange of ideas and information have accomplished a direct saving in individual problems. Articles and papers have described expedients and short-cuts. The result is a new fund of experience and a new interest in what others are doing—the stimulation of wider consideration.

Industry Standards

Perhaps our most important long-range program is the reduction in diversity of demands that we may effect by correlating our ideas for equipment and methods. We do not necessarily end with unanimity of opinion—the results fall somewhere between the two limits of no standards in the industry and a level of universal use of exact details. Manufacturing designs and the economy of quantity production assist in this direction.

The most satisfactory solution often follows joint consideration and action by our group and the interested manufacturers. Individual system construction details vary to a considerable degree and also our industry material standards should not stifle progress of new developments. The results must therefore be somewhat of a compromise—we will have something less than 100 per cent load factor.

The two extremes are perhaps best illustrated by bolt-and-nut specifications on one hand and switches at the other extreme. Quantity production and reduction of inventory are the objectives for hardware and several other items. Minimum designs and reduced special engineering are to be attained in the latter field. In some equipment, if all the output of all models and types were to be of one type and in one plant, it would not justify commonly called "production line manufacture." It is here that voltage standard ratings, test requirements, etc., become more important than rigid specifications.

Present Program

The keynote of this present meeting is the consideration of several pre-war subjects which we could advantageously complete for use in the immediate post-war period. Our inventories have been reduced and our warehouse stocks depleted and, when we can again purchase materials and equipment for construction, it will be most helpful if we can start on a basis of accepted standards and specifications. While our construction activities are at a minimum is the best time to consider and adopt changes in the methods.

Individually, we can review our material items, our lists of stock material, our company purchase specifications. We have cleaned out some stock that was gathering dust, and interest. In reviewing our lists and many of our practices, we can ask for each item: "Why do we need that?"

Most utility organizations have their general pattern for new substations, new feeders and further expansion. They are working on the plans for relief of overloaded lines and transformers, schedules for material purchases ready to serve promptly and to meet emergencies, and the immediate re-employment of personnel to restore normal maintenance and operation schedules. We should in our meetings exchange ideas of this nature.

Jobs to Finish Now

It would be a fine goal for our Committee and the groups with which we cooperate on several joint projects, to reach agreement and complete the task of adopting national industry recommendations or standards. There are several Joint and Sub-committees that have material on hand for such completion:

Preferred Voltage Ratings are fundamental in almost any consideration of material and equipment purchases. They are most important in the design of transformers, regulators, capacitors, arresters, fuses. Our consideration in this meeting should advance us a big step toward the desired table of preferred ratings. Our Committee and the Electrical Equipment Committee are working with a committee from NEMA on this joint project.

Distribution Transformer Standards

have been adopted and are quite generally recognized for single-phase transformers in the pole-mounted range of sizes. Reports of purchases have not been altogether encouraging for the standards, but we must remember that stocks of parts and assembled transformers and the designs under old standards were often available in a critical material market. This Committee still has the question of three-phase distribution transformers for consideration. We can settle the standard ratings, bushing arrangements and some other details so that post-war purchases may be in the designs that we can expect to be using in the years to come.

Fuse Cutouts. Ten years ago a Joint EEI-NEMA Committee was formed to formulate a standard on fuse cutout and link ratings. This group made a very definite contribution in the adoption of time-current characteristics for the coordination of fuses of various manufacturers. The type N link which resulted from their discussions appears to be quite generally in use.

Several short-comings of the report were found in practical use, however, and a proposal for revision and a type E fuse was made about five years ago. This had not been settled when the war caused us to drop this project. We propose now to reconsider the whole picture, reach agreement on several factors and adopt a standard that will include the coordination rating basis and test requirements. Steps have been taken to correlate our part of this project to a general test procedure being outlined by a committee of AIEE.

Hardware Specifications are perhaps the most difficult subject on our agenda. It is hard to arouse interest for discussion and equally hard to get individual companies to make any change in dimensions and details in their stock purchase. This is understandable because even some of the small changes may involve changes in drilling or mounting methods of some related items. We do have, however, a carry-over of a five-year program for completion of line hardware specifications which was started in 1938 but caught in the war. A committee for this job is being organized.

A Long-Range Viewpoint

After the war we can start a new program of construction, rebuilding, extensions, maintenance and rearrangement. New feeders and supply facilities will be needed. We can start exactly where we left off when the war began. Possibly, however, we could begin now to think about the distribution system for loads of a decade hence. With an accumulation of replacements and new work necessary, we might put some new ideas into practice. We may not be too far on the over-optimistic side if we think in terms of the load increases that took place in the decade after the first World War.

Perhaps there is an opportunity now for some imaginative engineering coupled with the hard facts and figures of existing investments. While we are not being pressed quite so hard on plans and blueprints for new construction, we may find some time to reflect on the fundamentals of delivering amperes from a central generator to customers' lights and appliances. It may be that not all of the ideas developed in growing to our present arrangements will appear to fit the pattern of further extensive growth.

We are delivering an average of 1,000 kwhr per year to our residential customers, with several times this amount in some sections. What will our system be like when we are delivering 10,000 kwhr per year in many large areas?

We have used poles, crossarms and weather proof covered wire for supply lines in most residential areas. Have the modern developments in cable changed the possibilities for overhead lines?

If the economics of distribution and demands in some areas appear to point toward more underground distribution, have we the best answer for feeder, transformer and secondary installation? Would some combination of underground and overhead be most economical for this general distribution with the loads we can expect in another 10 or 15 years?

We have related our substation transformer, regulator and feeder capacities to certain outage and emergency reserve requirements. More feeder ties, reduction of outages experienced and present emergency ratings may indicate a change in some system design factors.

We have street lighting systems that are inadequate for recognized traffic and safety standards. What is the best system for the growth that we can expect as the public demands better lighting? Do present and prospective secondary main loads change the comparison of multiple and series systems?

We have reduced lightning troubles on many urban distribution systems almost to the vanishing point or possibly to an economic minimum. We still have about as many short-circuit troubles as we did 20 years ago. What can we do about that?

We have constructed rural lines for loads that are served with 3 kva and even 1 kva transformers. The loads are mostly in the homes, to duplicate some of the conveniences of city residents. When electric motors are put to full use in the barn and farm yard, will our single-phase service be adequate? Will our outage experience stand with new dependence on service? Do we need further developments for the best combination of voltage control, feeder sectionalizing and protection?

Distribution in 1960

Many manufacturing plants have been forced by the war to completely dismantle their pre-war facilities. Many products will be superseded by entirely new designs in the post-war period. The manufacturing industry in general has a tremendous reconversion job when the war is ended. In the electric supply industry, we are still supplying kilowatthours very much as we have been, and as far as we can see now we will continue to supply the same kilowatthours for many years to come.

Distribution is the most flexible and at the same time the most expensive part of the electric supply business. It offers the greatest opportunities today for ingenuity in design and engineering. Imagination must be followed by calculations and sound judgment, but it may well precede proposals for major expansion and expenditure. The Transmission and Distribution Committee will be following its traditional plan of operation in keeping abreast of these possibilities, and in leading this trend of thinking and questioning.

I propose that at the next meeting of our Committee we should have a symposium on imaginative engineering for post-war consideration. We might well have several reports on the subject "A Distribution System for 1960 Loads." Some ideas may even be considered radical and the whole idea may be considered unnecessary by some who are less optimistic about the future. Nevertheless it will do us good and I hope there will be so many proposals to discuss that we can select one group for the May meeting and have a nucleus for still another meeting along this line next fall.

Job Appraisal Plan of The Detroit Edison Company

By Lynden J. Kaufmann

Employment Bureau, The Detroit Edison Company

Reprinted from Synchroscope, company publication of The Detroit Edison Company

REGIONAL WAR LABOR BOARD REGION XI

THE Job Appraisal Plan described by Mr. Lynden J. Kaufmann in the accompanying article was submitted to the Regional War Labor Board, Region XI, and approved so far as the plan itself was concerned, and also as to a proposed plan for granting merit increases thereunder. Two other proposals in the same application were denied. One of these was to provide for payments of 10 per cent above the scheduled rates for exceptional employees, and the other was for approval to grade new occupations, or re-grade present occupations, within the framework of the plan. It was required that such action shall be submitted for approval. Excerpts from the opinion of the Regional Board are given hereunder.

— — — —

"The plan itself is a point rating system of the type frequently used in job evaluation and represents a careful attempt to rate job classifications according to their relation to each other. The plan has been worked out painstakingly and scientifically over a considerable period of time and represents a genuine effort to achieve sound and stable personnel relations. The company has been, for many years, a leader in progressive personnel practices in this area, and this plan marks a new forward step in the direction which the company has always pursued.

"The plan which is now in existence is the same plan which was in existence January 1, 1941. The levels of the ranges in this plan have not been raised since that time, nor have any general increases been given by the company. The proposed plan has been under study since January, 1942. Thus, the proposed increase which will result from the institution of the new plan can properly be approved by the Board under the maladjustment formula. The net effect of approving an increase in the general level of the company's rate ranges will be to allow merit increases at a level approximately 12.6 per cent higher than the level within which merit increases could be given on January 1, 1941. An approach of this type, it seems to us, is the most feasible way to apply the maladjustment formula to office employees. In these cases, increases are rarely given as general increases, making the usual application of the "Little Steel" formula, and where general increases are given it is difficult to disassociate the merit factors from the other factors, such as cost-of-living.

"Two proposals of the company, the Board is compelled to deny. The first is a request to pay exceptional employees up to 10 per cent above the schedule of rates proposed under the point rating system of evaluation. This is in effect a blank check to the company to give increases in excess of the amounts which would be permitted under the maladjustment formula, and, in many cases, in excess of our bracket maxima. . . . A second proposal which we cannot grant is a request to rate new occupations or to re-rate present ones when revisions appear necessary as a result of further study. This virtually amounts to a request for authority to allow wage increases for the purpose of correcting internal inequalities on the basis of the company's point rating system. . . . The reason for an increase in rate for any specific classification may well be related to manpower problems, and there are very few point rating systems which are not sufficiently flexible that they cannot be stretched to meet manpower situations."

IN a small company with few employees the manager is able to judge, on the basis of personal acquaintance with the employee, his occupation and his performance, how much he should be paid, within the general limits of what the company can afford to pay. As an organization grows in size and complexity, and occupations become numerous and more specialized, it becomes more and more difficult to judge accurately what pay ranges should apply to them.

For the most part, pay rates have been determined largely on the basis of job-to-job comparisons of a general sort, both within and between companies and industries. This method gives satisfactory results on the whole, and many companies believe these results are as accurate as those that can be obtained by other methods. For years, The Detroit Edison Company has operated on such a basis.

Starting in the 1920's, however, a few companies began to study and use more careful and logical methods of determining the values of different kinds of work, which have provided more accurate results than those obtained by the older methods. Progress was slow, but steady, and our Company became interested. After investigating many different plans, it was decided to adopt one of the plans known as "point rating" and to review all kinds of work on the weekly and hourly payrolls of our Company, with the aid of a consulting firm. The consultant selected had developed a formula, or rating scale, for appraising occupations which had been successfully used by a number of companies in the electric power and light industry, and so was well recommended.

The point rating scale measures the relative value of occupations on the basis of five major factors: responsibility; knowledge, skill and experience; work complexities; contacts; and general working conditions. Each of these major factors is sub-divided into from two to four sub-factors, and the sub-factors are further graded into six degrees. Each degree is defined in general terms, and is given a value in points. Every factor of the scale is given a weight which expresses its relative importance. These weights have been determined over a period of several years of use in companies such as ours, and are believed to be accurate for our industry.

The major factors, sub-factors, and their weights are as follows:

RATING SCALE

Factor	*Weight*
A—Responsibilities (165)	
1. Responsibility for Supervision	100
2. Responsibility for Handling Confidential Matters	20
3. Responsibility for Safety of Others	25
4. Responsibility for Performance of Work without Immediate Supervision	20
Total	165
B—Knowledge, Skill, and Experience (80)	
5. Specialized or Professional Knowledge Required	30
6. Manual or Other Physical Skill Required	20
7. Company Experience Required	30
Total	80
C—Work Complexities (110)	
8. Complexity and Difficulty of Work	90
9. Seriousness of Errors	20
Total	110
D—Contacts (70)	
10. Contacts with Customers, or Other Companies	50
11. Contacts with Other Departments	20
Total	70
E—Working Conditions (40)	
12. Hazards	30
13. Irregularity of Hours and/or Adverse Working Conditions	10
Total	40
Grand Total	465

Each sub-factor is defined as to scope, and the significance of each degree is explained in general terms. A typical page from the Rating Scale follows:

"B—KNOWLEDGE, SKILL AND EXPERIENCE

7. Company Experience Required .....(30)

Under this factor, consider the range and length of experience, in related or lower jobs, necessary as preparation for or leading up to the particular job being rated. Wherever possible, measure this in terms of experience *within* the Company.

Degree Definitions

Degree	*Point Values*
None	0
1 Preparatory experience ordinarily gained in approximately three or four months of employment with the Company	3
2 Experience ordinarily requiring six months to one year of work with the Company	5
3 Experience ordinarily requiring from one year to one and one-half years of work with the Company	7
4 Experience ordinarily requiring from two to three years of work with the Company	11
5 Experience ordinarily requiring four to six years of work with the Company	18
6 Experience ordinarily requiring not less than eight to ten years of work with the Company	30

In rating occupations, the whole series of occupations under review is considered with respect to one factor at a time. If the factor applies to the occupation, the proper number of points is selected by reference to the table of degree definitions. When all factors have been completed, the points assigned to each kind of work are added, and the resulting total expresses the relative position of the work in the Company as a whole.

The rating, or appraising, of occupations was done by a committee of employees under the guidance of the consultant. Membership of the committee changed to some extent as the study progressed, but it always included one or more representatives of the department whose occupations were being reviewed, and two employees who were assigned to work with all departments to assure correct and uniform application of the scales. As the Company men gained experience and skill, the consultant gradually withdrew.

In rating occupations, the committee studied job descriptions, prepared by the department concerned, which gave a brief but complete statement of the duties and responsibilities pertaining to each occupation. These were important, not only as a matter of record, but to make sure no significant part of an occupation was overlooked.

Decisions of the committee were reached by discussion of the facts presented, or questioning, until all members were in agreement on the number of points to be assigned for a factor.

Nearly every occupation on the weekly or hourly pay rolls has been rated by the committee, and a large majority of employees in the Company are now paid on the pay schedules which have been developed as a result of the study.

While the foregoing explanation deals only with occupations and their pay rates, the individual employee has not been forgotten. What the job appraisal study has done is to determine a fair minimum and maximum rate of pay—in other words, a range for each kind of work done in the Company. The employee's pay rate within the range, as well as his opportunities for promotion, are dependent on his personal qualifications, abilities, and effort.

Long Range Values

(*Continued from page* 85)

on fundamental improvements in the line.

Fourth—Get these improvements into the product *promptly* to stimulate rather than stifle progress.

As I have said before, the manufacturers cannot carry the ball (or perhaps I should say "the bag") all by themselves. The utilities also have their part to perform if this program is to be successful. It is absolutely essential that the utilities diligently and consistently pursue the policy and practice of applying standards wherever possible. It is not enough to agree on standardization in principle, or to accept a set of standards on paper. The utility must carry through by making the use of standard equipment a definite part of its purchasing policy. One utility executive has suggested that in connection with system changes or expansions, those responsible should be required to demonstrate why a standard article cannot be adopted in any case where the use of nonstandard equipment is being proposed. Utility purchasing agents can make a vital contribution in this carry-through phase of the program.

A good start has been made toward standardization of electric apparatus. The big problem is to obtain widespread *acceptance* of the standards established. The EEI Post-War Planning Committee, which has shown considerable interest in this matter, has pointed out that "the problem of securing acceptance of standard or preferred ratings and sizes is substantially more difficult than a joint committee's task of agreeing upon and writing these standards." Can't we all get behind this with the hope of accomplishing in the next few critical years a degree of standardization which will take a decade or more if left to hit-or-miss methods? Let's not be like the passengers referred to by the Pullman porter who, when asked by a novice traveler what the standard tip was, replied, "Well, suh, the *standard* tip is one dollah, but I ain't never yet found anybody that lived up to the standard."

Distribution Transformer Protection Problems

By J. B. Hodtum

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THE purpose of this discussion is to point out some of the factors involved in the various protective schemes used on Distribution Transformers. In general, however, they would apply to any transformer of any voltage.

Essentially, the transformer consists of three elements and for the purpose of surge voltage distribution are related as shown in Fig. 1. This figure may be simplified as shown in Fig. 2, where

a = capacitance between high voltage winding and tank

b = capacitance between high voltage and low voltage windings

c = capacitance between low voltage winding and tank

In this figure, the inductance of the windings is neglected, since it bears very little relation to the initial voltage distribution between the various elements. If the tank could be thoroughly isolated it would assume a potential proportional to the relative capacitances a and c. In other words, the tank potential would lie somewhere between the high voltage to ground and low voltage to ground potentials. The tank, however, is affected by its external resistance, or impedance, to ground, which may overcome the controlling effects of the capacitances a and c for figures 3, 4, 5 and 6.

Z_H is the arrester lead reactance, due to its physical length, and the ground resistance.

Z_L is the impedance of the secondary circuit from the transformer to its point of grounding and the ground resistance.

Z_T is a variable and depends upon the leakage circuit from the tank to ground on the pole or hardware.

Figure 3 shows the relations when there is no interconnection of the arrester ground with either the tank or low voltage circuit.

The high voltage winding rises to a value above ground equal to the impedance drop through the arrester and its ground impedance Z_H.

The low voltage winding, which carries very little surge current, will remain nearly at ground potential.

The tank potential is controlled by the capacitors a and b together with the leakage circuit Z_T.

If Z_T is high, the tank potential rises to a value between the high voltage and low voltage potentials to ground. If Z_T is low, the tank approaches ground potential. The voltage, therefore, across the high voltage bushings, depends upon Z_H, Z_T and the surge current magnitude.

The voltage between high voltage winding and low voltage winding depends upon Z_H, Z_L and the surge current magnitude. For these reasons this is not a desirable connection.

Figure 4 represents a solid interconnector between the lightning arrester ground terminal and the secondary neutral. Again the voltage appearing in the high voltage winding is due to the impedance drop of the arrester and its ground resistance. Since the arrester is connected directly between the high voltage and low voltage windings, the low voltage winding rises until it differs from the high voltage winding by the arrester impedance drop. The tank potential may then vary anywhere between the low voltage potential and ground, and is affected by the same factors as under Fig. 3.

Figure 5 represents a transformer having an interconnection which includes the tank. The tank in this case is solidly connected to the low voltage neutral. All the connections from the high voltage winding through the arrester to the low voltage and tank must be kept as short as possible in order to reduce the impedance drop.

This case indicates that the voltage that may appear between the high voltage and low voltage windings and between the high voltage winding and tank, is fixed by the arrester impedance drop only, and is independent of the arrester ground impedance. This type of connection would afford maximum protection.

Figure 6. For this connection the tank is permitted to be ungrounded but is protected by a spark gap connected between the secondary neutral and the tank.

During the first part of the surge, the tank potential is controlled by its leakage impedance to ground and therefore is at a substantially lower voltage above ground than is either the high voltage or low voltage windings. If the gap is so adjusted that it will flash over before the voltage between the tank and the high voltage winding exceed the flash over value of the high voltage bushings, the voltage across the high voltage bushings reduces to the arrester impedance drop and therefore does not cause flash over.

If this gap, however, is set too wide a flash over will occur across the high voltage bushings to tank, resulting in a flash over of the secondary gap, resulting in a fault to ground which will blow the primary fuse. These two conditions are shown as points x and y of Figure 6. For the case x the secondary gap flashed over before the voltage between the tank and high voltage winding was high enough to cause breakdown of high voltage gap. For case y the gap was set too wide, permitting a high voltage flash over resulting in a fault to ground and failure of the fuse.

When the high voltage bushing flashes over it undoubtedly results in a power fault to ground when the system has a solidly grounded neutral. When the system is an ungrounded delta one, the current may not be of sufficient magnitude to blow the primary fuse. It therefore follows that there is to be some difference expected in the performance of such a connection on grounded and ungrounded circuits relative to fuse blowing.

From this it appears that it is essential that the interconnection include all of the elements to control the voltage appearing within a transformer or over its bushings. If the tank is solidly connected to the secondary neutral, maxi-

mum protection is afforded. When the case is gapped to the secondary neutral the effectiveness depends upon the flash over value of this gap. In other words, the voltage appearing between the high voltage winding and tank or across the high voltage bushing, is equal to approximately the flash over value of the secondary gap plus the arrester impedance drop.

In some cases due to company rules or legislation, solidly grounding the tank is not permitted, although this gives the maximum protection to the transformer and fuses. Where it is not permitted to solidly ground the tank, the connections of Fig. 6 should be used, but the tank gap to secondary neutral must be adjusted so that it flashes over before the high voltage bushings flash over. With this type of connection the only current that will flow across the secondary gap is the necessary capacity current to control the tank potential to ground. No power current will flow across this gap.

A study has been made covering three years of operation of transformers on the systems of member companies of the Pennsylvania Electric Association. This data includes a fuse blowing rate, transformer failure rate and minimum fuse size. The data has been plotted in Fig. 7. Curve A of this figure indicates that there is a relation between the size of the fuse and its blowing rate, the percent blowing decreasing as the fuse size is increased.

Curve B of Fig. 7 shows data taken from the April, 1941, issue of General Electric magazine "Distribution." It shows the percentage of surges in excess of given crest current value. For example, surges in excess of 15,000 amperes occur only about 2.6 per cent of the time. Curve B lies almost parallel to Curve A.

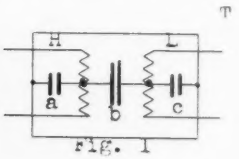


Fig. 1

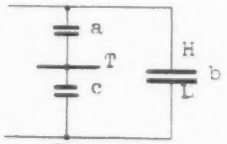


Fig. 2

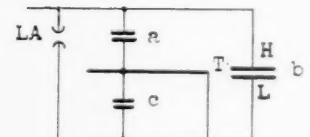
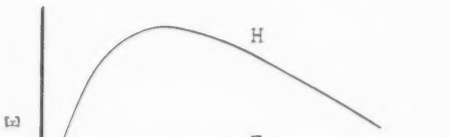
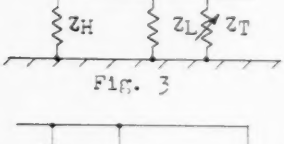


Fig. 3





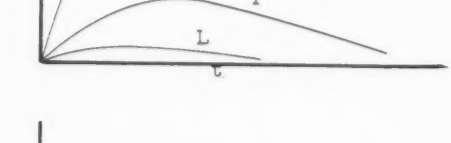
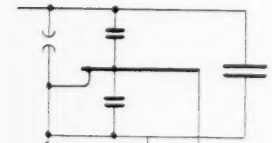


Fig. 4



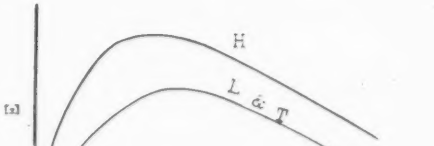
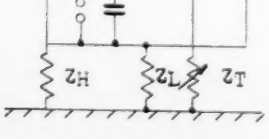


Fig. 5



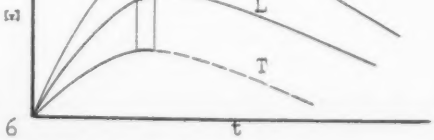
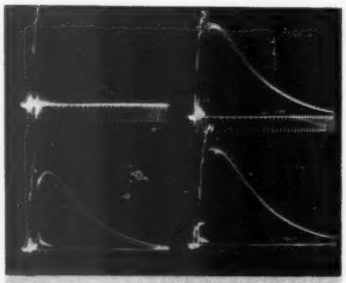
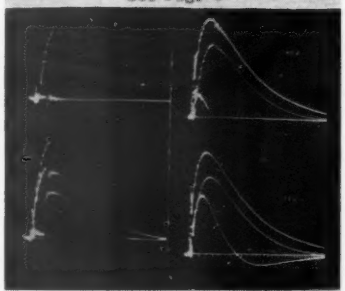
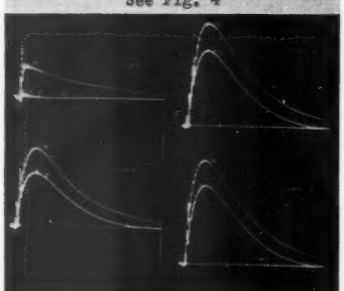


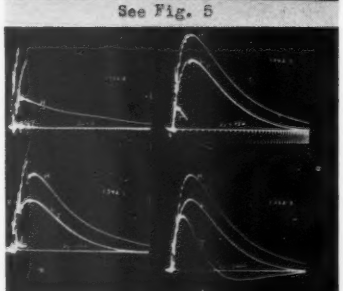
Fig. 6

Figs. 1-6, Inc.


See Fig. 3


See Fig. 4


See Fig. 5


See Fig. 6

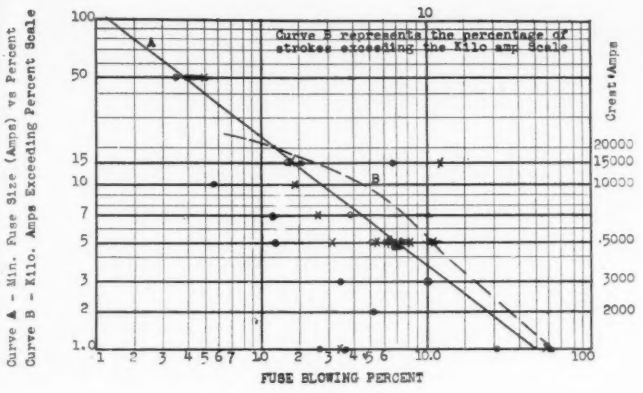

Curve A - Min. Fuse Size (Amps) vs Percent
Curve B - Kilo. Amps Exceeding Percent Scale
Curve B represents the percentage of strokes exceeding the Kilo amp Scale
Crest Amps
FUSE BLOWING PERCENT

Fig. 7

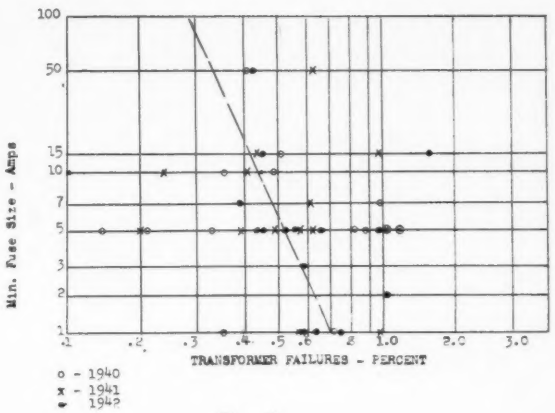


Fig. 8

This seems to indicate that most fuse blowing is due to surge currents.

Figure 8 shows the percentage transformer failure rate against fuse size for this same group of companies. While the points are quite scattered, there appears to be a trend that the transformer failure rate will decrease with increased fuse rating.

One explanation for this condition is that during the surge discharge the transformer is subjected to a direct current component of current. This results in the saturation of the core iron. Should the fuse blow at this time, due either to excessive surge current or excessive magnetizing current, or both, the transformer may fail from the inductive kick developed within the windings. If the fuse does not blow, the inductive field is absorbed by the system in the same manner in which a discharge resistor aborbs the kick when a d-c field winding is opened.

Since Figs. 7 and 8 indicate a reduction in number of fuse blowings, and the possibility of decreased transformer failure rate with increased fuse ratings, it is suggested that a primary fuse at the transformer be increased to the maximum size which can be cleared for a 2-wire fault at the end of a 3-wire secondary. Chart Fig. 9 indicates a method for determining the maximum fuse size when the transformer rating, size and length of secondary are known. An example on this drawing is shown on the dashed lines which indicates that a 2-wire fault at the end of 800 ft. of No. 6 secondary supplied from a 1½-kva transformer will develop eight times full load transformer current on the high voltage side. The proper fuse therefore is one which will clear for a fault of eight times the transformer rating. The Chart also indicates

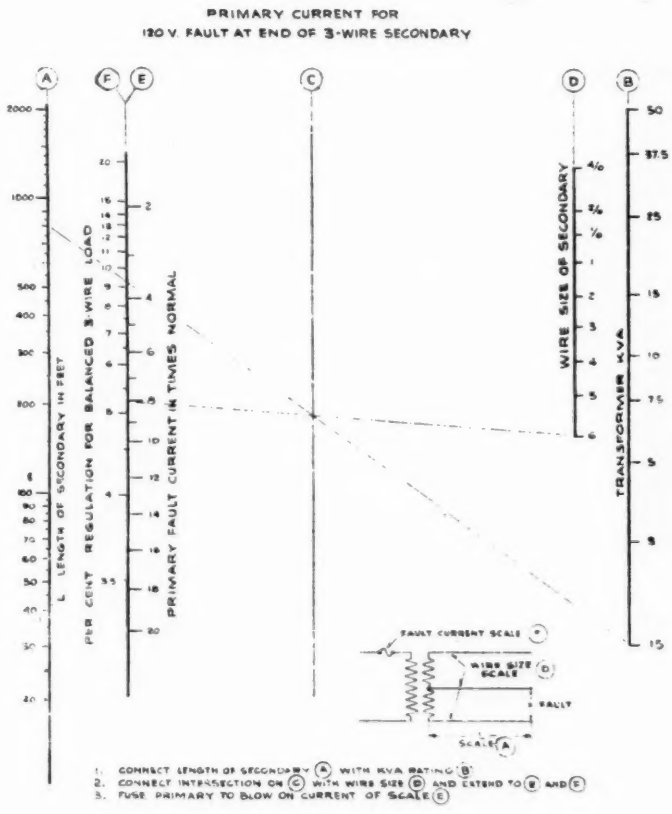

PRIMARY CURRENT FOR
120 V. FAULT AT END OF 3-WIRE SECONDARY
A
F
E
C
D
B
L LENGTH OF SECONDARY IN FEET
PER CENT REGULATION FOR BALANCED 3-WIRE LOAD
PRIMARY FAULT CURRENT IN TIMES NORMAL
WIRE SIZE OF SECONDARY
TRANSFORMER KVA
FAULT CURRENT SCALE
WIRE SIZE SCALE
FAULT
SCALE A
1. CONNECT LENGTH OF SECONDARY (A) WITH KVA RATING (B)
2. CONNECT INTERSECTION ON (C) WITH WIRE SIZE (D) AND EXTEND TO (E) AND (F)
3. FUSE PRIMARY TO BLOW ON CURRENT OF SCALE (E)

Fig. 9

the regulation with the load concentrated at the end of the secondary.

Conclusion

Conclusions drawn from this study show that in order to protect the transformer against lightning interruptions and to reduce the number of fuse outages, it is necessary:

(1) To fix a potential between the tank and windings. This may be accomplished by either solidly connecting the tank to the secondary neutral and the arrester ground terminal or by gapping the tank to the secondary neutral and arrester ground terminal through the proper size of gap.

(2) If the primary fuse rating can

be increased, the number of fuse blowings should decrease. This may also lead to fewer transformer failures.

(3) If the transformer failure rate due to lightning is caused by the inductive kick developed within the winding due to the blowing of the fuse, better transformer protection would be obtained if the lightning arresters were installed on the load side of the fuse. For this connection, however, the smaller fuses would blow due to excessive surge currents. A compromise might be that for fuse ratings below 15 amperes that the arrester be connected to the line side of the cutout, and for fuse sizes above 15 ratings the arrester be connected to the load side of the fuse.

APPENDIX

A 3 kva 2400-120/240 volt transformer was set up in the Surge Laboratory and the connections of Figs. 3, 4, 5 and 6 were surge tested.

For all of these tests Z_H was adjusted for 100 ohms resistance, Z_L for 250 ohms. Impedance Z_T was adjusted for 0, 100, 750 and 7000 ohms. Cathode ray oscillograms were taken for each condition.

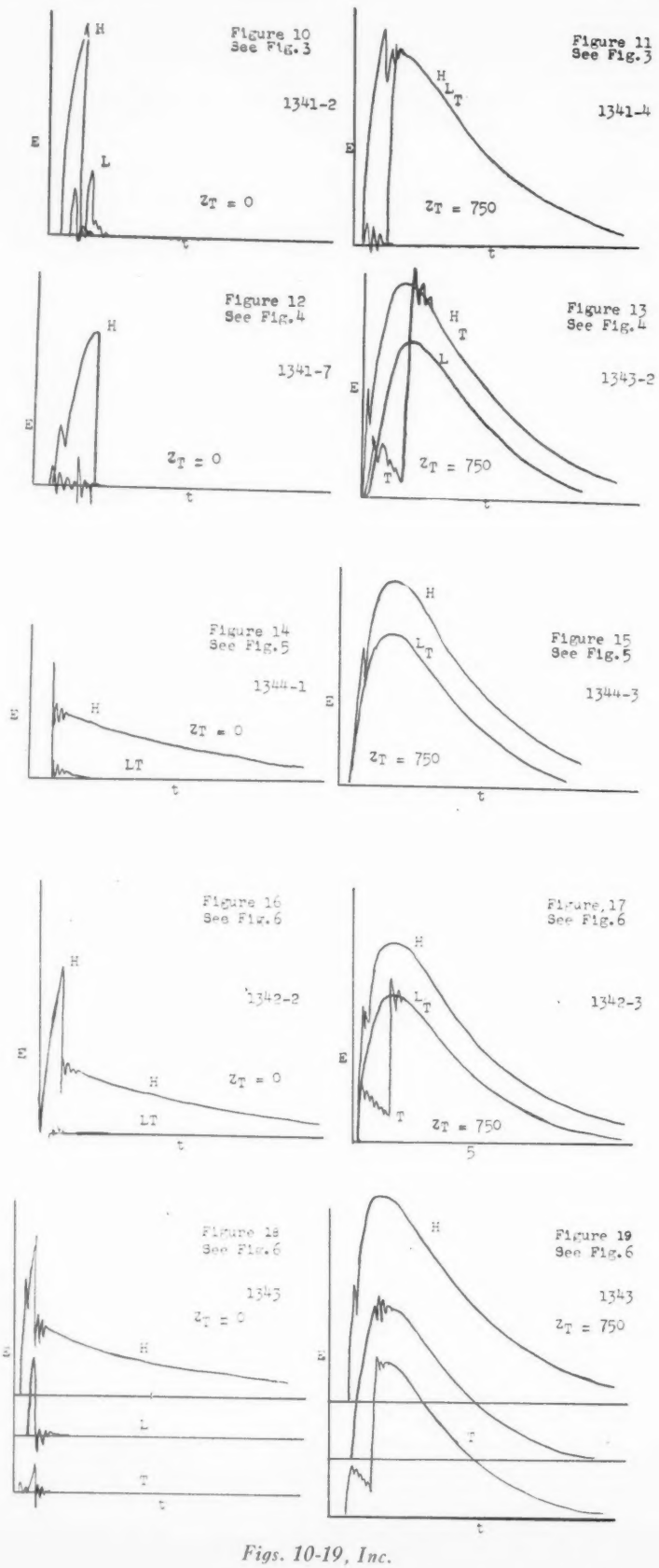
The arrester used was a 2400 volt valve type. The high voltage bushing was gapped for ¾ inch spacing.

Figures 10 and 11 correspond with Fig. 3 and represent the non-interconnection. Figure 10 is for $Z_T = 0$ ohms and Figure 11 is for $Z_T = 750$ ohms.

Figures 12 and 13 correspond with Fig. 4. In Fig. 12, with $Z_T = 0$, the high voltage bushing flashed over. Since the tank was solidly grounded, all voltages reduce to 0. In Fig. 13, where $Z_T = 750$ ohms, the high voltage bushings flashed over. The voltage difference between H and L is the arrester impedance drop. This is the condition for Fig. 6 when the tank gap is too wide. Figures 14 and 15 correspond to Fig. 5. For these cases no bushing flash overs occur. The difference in voltage between H and L remains constant for $Z_T = 0$, 100, 750 or 7000 ohms.

Figures 16 and 17 correspond with Fig. 6. For this case the low voltage always flashes over first thus preventing a fault between the high voltage and ground.

Figures 18 and 19 also represent Fig. 6, except that the scales have been shifted in order to see the voltage trace of each element separately.



Figs. 10-19, Inc.

Long Range Values in Standardization of Electric Apparatus

By H. V. Erben
General Electric Company

Presented before the Public Utility Buyers Group of the National Association of Purchasing Agents, Chicago, Jan. 24, 1944.

WHAT does the word "standardization" bring to your mind? To me, the standardization of heavy electric apparatus means the channeling or directing of purchases into a relatively small number of types and ratings, selected so that they will meet the requirements of the vast majority of applications. By concentrating engineering and manufacturing talent on fundamental improvements in these standard ratings, it will be possible for the electrical manufacturers to achieve a degree of perfection in design and in manufacturing methods which is unattainable with special "one-of-a-kind" designs, except at prohibitive cost.

Why is standardization of particular importance to the utilities *now?*

It seems certain that the utilities will continue to be burdened with high tax loads and high labor costs after the war. In the face of continuing pressure for *lower* rates, there is certainly no assurance that the resultant increase in operating costs can be compensated for by *higher* rates. Unless utility profits are to suffer, means must be found to reduce *other* items of cost. Standardization of electric apparatus may offer at least a partial solution, because experience shows that, in general:

First: The installed cost of standard apparatus is lower than that of special or piece-meal designs. This results directly in a reduction in capital charges.

Second: The simplicity in specifying, ordering and co-ordinating purchases of standard apparatus, as well as the flexibility of its application result in savings in operating cost which, although difficult to estimate to the last dollar, are tangible and very considerable.

Standardization of electric apparatus is by no means a new and untried idea. The great reduction in cost and improvement in product which standardization has made possible on such items as incandescent lamps, watthour meters and wiring devices, are well known. Through the joint efforts of EEI and NEMA, important steps have been taken for simplification and standardization of power circuit breakers and distribution transformers. In the field of *heavy* apparatus, however, there has been almost no standardization. Indeed there was little interest in this direction until the war brought experience in the repetitive manufacture of equipment comparable generally with that used by utilities.

In our wartime experience, and in that of other manufacturers, it has been demonstrated that cost savings of a surprising magnitude, together with very tight quality control, are possible through standardization and repetitive manufacture. For example, at one of the new turbine shops set up for the manufacture of propulsion turbines for destroyers and heavy cruisers, two years were required to produce the first 100 shafts. Turbines for the second 100 shafts were produced and shipped in seven months. The original production schedule at that plant called for *only 48 shafts a year.* Significant from a postwar standpoint is the fact that cost went down as production went up. This destroyer propulsion equipment, consisting of two turbines for gear drive, is now being furnished at a cost *one-third less* than that for the same equipment in 1939.

Turbines

Since the discussion of apparatus standardization at the EEI Annual Meeting last June, perhaps more interest has been shown in standardization of large land turbine generators than in any other type of equipment. This is probably due in part to the disclosures regarding wartime experience in turbine production and also due to the fact that turbine generators are large, costly, and spectacular. Yet, in my opinion, the large utility turbine is probably not the most likely field for standardization. Other lines of apparatus would seem to show more promise of immediate results. This is so because even under the most optimistic estimates of postwar business in large turbine-generator sets, the number of units which a manufacturer may be called upon to build is quite small. However, an ASME Committee is working on the establishment of preferred sizes, temperatures and pressure for turbines. Similar activity by AIEE is underway on generators, and it is likely that specifications for new machines will tend to cluster around these preferred ratings.

Although savings as large as those obtained in the wartime production of ship propulsion turbines seem unlikely in the case of large land units, because of the relatively smaller number purchased, there is still great opportunity for repetitive manufacture of important component parts. For example, identical exhaust hoods, governors, diaphragms, buckets, and even in some cases shells and shaft forgings, can be used for a variety of machine ratings. When the demand is sufficient, advance stocks of parts can be ordered and machined, and stock units may be partly fabricated. This would make possible shorter shipment and at least some lowering of cost.

Repetitive manufacture of mechanical drive turbines has already reduced the price an average of 10 per cent and produced a better product, which can be built and shipped in a shorter time. In our case, one basic design in three standard sizes is applicable to a large variety of ratings. Engineering time formerly required for routine calculations incidental to special designs is now concentrated on fundamental developments and improvements in the line. Engineering progress has, therefore, been accelerated rather than retarded as many people have feared.

Power Transformers

I believe that the power transformer offers the utilities and the manufacturers a most fruitful field for co-operative standardization. Yet to date only a start has been made. In 1941, studies along these lines were begun.

The line of standardized power transformer designs is rapidly being completed, and general acceptance of this

program to date is gratifying. This is indicated by the receipt of more and more inquiries for propositions on standard ratings. Further economies in manufacturing costs and resultant lower price levels will be obtained if a larger percentage of total output is in standard ratings. Furthermore, very much shorter shipment is possible on these standard designs.

The effect of planned repetitive manufacture on cost of production is illustrated strikingly by our experience with a large order for power transformers for a war project. First, costs were determined based on conventional designs and manufacturing methods suitable for "one-of-a-kind" production. Then, because of the large number of units to be built, it was decided to design these units and plan our manufacturing operations in such a way that economies from repetitive manufacture would be made. Standard pre-assembled terminal boards and interchangeable cores and coreclamps were adopted, and substantial economies were made in the load ratio drive mechanism, reactor and housing. The transformers were put through the shop in batches of 20 or more at a time. When they were completed, it was found that the manufacturing cost of these transformers was very appreciably less than would have been the case if the same number of units had been built on many orders each covered by a different specification.

Cable

In July, 1941, the AEIC published specifications for paper-insulated cable under what they called a "Simplified Practice Schedule." This covered preferred sizes, voltages, strandings and construction.

Although some utilities have followed these recommendations diligently, the general acceptance has been disappointing. Perhaps, because of the wartime restrictions on utility construction, purchases have not been made in sufficient volume to encourage the change in practice. On the other hand, the price reduction of about 2 per cent may not have offered adequate inducement.

Little can be accomplished in the actual application of cable standards until the war is won, when restrictions on utility construction and CMP regulations governing the processing of copper are removed. At that time, if standards acceptable to the utilities have been established and are followed in practice (avoiding those seemingly slight variations from standard which increase cost so much), I feel sure that the manufacturers will be able to offer more substantial price differentials in favor of the standards. Also, by accumulating materials and parts in advance of receipt of orders, they will be able to make shorter shipments.

However, right now is the time to discuss and decide on the standards. If any revision in the AEIC standards on paper-insulated cable is needed, it should be made now. Also, consideration should be given to the development of similar standards for other forms of cable used regularly by utilities.

Unit Substations

This equipment offers an interesting example of the application of standardization to a "package" article. Here, by careful study of the field requirements, it was found possible to develop a relatively few standard components which can be assembled into a great variety of combinations. For example, it was found that in the load center transformer standardization program there were 648 types of units that might be required for adequate coverage, yet the annual demand in any particular combination is in the order of 50 or less. Despite this great number of arrangements, the line is now covered by 18 standardized tanks, 18 cores, 2 junction boxes, 3 switches, and 2 metal-enclosed interconnections to switchgear. This limited number of parts can be stocked in reasonable quantities of from 5 to 20, making possible marked savings in the cost of manufacture and greatly reducing the time for shipment.

The fact that users and contractors can save time (*which means money*) by purchasing standard unit substations is well illustrated by experiences with two Army camp power supply jobs in the Middle West. In one case, the customer's engineers were favorable to the use of unit substations.

Our representative arrived at the camp site at 10 a.m. By 4 p.m. the decision to provide a 4 kv primary network had been made, location of lines and substation had been established and guide form specifications had been prepared. Three days later complete specifications and invitations to bid were issued. In three more days, bids were in. After a few days of negotiation, an order was placed for unit substations, necessary connecting cable, structures, etc. The total elapsed time between authorization to proceed with this work, and the ordering of all apparatus was only *nine days*.

However, at another camp it was decided to write specifications and take bids on a substation and distribution system, on a "nut and bolt" basis. After several weeks delay, very general specifications were issued. Bids were received on certain parts of the equipment, but none on other parts. Accordingly, it became necessary to rewrite the specifications and reissue them for bids. More than six weeks elapsed before all equipment was ordered. We understand that the power system cost per soldier at this camp was extremely high.

Switchgear

Probably more attention has been directed to standardization in switchgear than to any other heavy apparatus line. A program of simplification of power circuit breakers was begun under the sponsorship of EEI, AEIC and NEMA more than 15 years ago. In 1928, manufacturers listed some 470 high voltage, outdoor type oil circuit breakers. Through the efforts of this Committee, the number of outdoor ratings is now less than 50 (a reduction of 90 per cent). The work is being continued, with the objective of further reduction to possibly not more than 25 ratings in this field. This standardization, and the repetitive manufacture which it made possible, has resulted in price levels for outdoor circuit breakers about 15 per cent below those of 1937 or 1938. This has been accomplished in spite of large increases in material cost and wage rates during this period, and in spite of the extra cost of major improvements and refinements in the product.

Progress has also been made in the standardization of indoor station type breakers for 15 and 23 kva service, 500,000 through 2,500,000 kva interrupting capacity. The number of ratings in this field has been reduced from about 760 in 1928 to *18* today. In spite of the curtailment in large station construction over the past few years, standardization on the limited number of ratings has enabled us to make a 10 per cent reduction in the price of station type breakers, since 1935.

The development of modern vertical-lift metal-clad equipment for medium voltage service also began around 1928. At that time, approximately 360 different types and ratings of oil circuit breakers were used for circuit protection and

switching in the 2300 volt to 15,000 volt range. The housings or mountings furnished were special and the number of varieties ran into thousands.

By 1935, the merits of metal-clad construction had become recognized. A "master" type, totally enclosed, factory-assembled unit, including a breaker and its associated current transformers, disconnecting devices, bus and connections all assembled in a compact steel housing, was offered at a price competitive with open-type switchgear. Further price reductions were made in 1939 and again in 1942, so that today a vastly superior metal-clad equipment is being produced and sold at a price about 35 per cent below that of 1935.

How has this been accomplished?

First, the number of breakers required to cover this field has been reduced from 360 to 32 (a 90 per cent reduction), and it is hoped that ultimately only 16 breaker ratings will suffice.

Second, standardization in the housing and associated equipments has been even more astonishing. Today, instead of thousands of special housings or mountings, we have just *three* frames sizes of metal-clad units which cover the entire medium voltage range, housing breakers from 25,000 through 500,000 kva interrupting capacity. This reduction in number of varieties made possible repetitive manufacture, and with assembly line production our cost was reduced. It has been our happy privilege to pass this saving on to our customers through price reductions which, as I have previously mentioned, now total approximately 35 per cent.

I believe that the history of standardization in switchgear is an excellent example of what can be accomplished through repetitive manufacture of heavy electric apparatus and one which can be extended profitably to other lines.

Review of Advantages from Standardization

It seems natural that customer interest in standardization has been stimulated chiefly by the prospect of *lower price levels*. It is true that manufacturers have found it possible to offer price inducements on selected popular ratings and designs. The amount of price differential varies. It has been as little as 2 or 3 per cent in cases where *very few* duplicates are built, and it may be in the order of 20 or 30 per cent or more in cases where nearly all purchases can be channeled into a relatively few ratings or combinations of standard devices, so that true mass repetitive manufacturing methods can be employed.

Obviously, if the same facilities must be used for the production of *both* standard and special apparatus, the possible saving in cost is limited. If as little as 20 or 25 per cent of the output is special, the cost of producing these specials becomes very high relatively. To date, each manufacturer has selected ratings which *he* considers as standard, based on his own experience and judgment. These ratings have not *always* reflected the true requirements of the users generally. What is standard for one manufacturer is likely to be special for another. To be competitive, all manufacturers have, therefore, been forced to price their specials at levels not much higher than the standards, regardless of their higher costs. As a result, a portion of the excess cost of the specials has been borne by the standard items, and it has not been possible to pass on to the user the full benefits of the savings which accrue from repetitive manufacture. It seems to me that this is *wrong*. If the utility industry and the electric equipment manufacturers can work together in establishing standards which the utilities will willingly purchase in preference to the specials, whenever the standard item will meet the requirements, we feel sure that the price differential in favor of standard equipment can be increased materially.

However, it should be recognized that lower equipment price is by no means the *only* advantage to be obtained from standardization. The manufacturer of standard apparatus can generally produce the complete equipment or component parts in anticipation of receipt of orders. Shorter shipment is, therefore, possible, delays due to failure in production are reduced, and a more uniform factory load is obtained. Also, the purchaser finds that complete information on the product is more readily available, and the preparation of specifications and placing of orders is simplified. Dimensions and outlines can be obtained quickly and installation time and money are usually saved through purchase of package equipment. If the power system is designed around standard equipment, greater flexibility is obtained as more and more standards are installed. Standard apparatus can be moved from one location to another as load requirements shift or grow. Fewer renewal and replacement stocks are needed because the same parts are applicable to many equipments. Many of the more popular ratings of standard apparatus will be available from manufacturers' stock, reducing the inventory requirements of individual purchasers.

Another advantage which the utility gains from use of standard apparatus is that utility engineers are relieved of the burden of detailed equipment design and the study of manufacturers' catalogs covering hundreds of "nut and bolt" items. Thus, their time and effort can be devoted directly to the study of the basic problems of power system design.

In this connection there is a growing tendency toward diversity of location and flexibility in arrangement in power system design. This trend favors lower power system cost, because it leads to increased simplicity of system design and results in the use of more and smaller units which can be produced in quantities.

Experience has shown that the system designer has a relatively wide freedom of choice, from the standpoint of over-all economics, in the selection of types and ratings of equipment, and even in the voltages and general pattern of his power layout. The fact that the power system designer has this wide range of choice, all approximately equal from the standpoint of over-all economics, leads to the conclusion that he can consolidate his equipment requirements into a relatively small variety of ratings, types and voltage classes. If he does this, manufacturers will obtain low-cost quantity production, permitting price reductions which will result in a net gain to the system designer and his management.

Conclusions

This is a co-operative job. It can't be done by one manufacturer, or even by all manufacturers working together. The utility industry and the electric equipment manufacturing industry must work together. The manufacurers must then:

First—Alter their designs and manufacturing methods, when necessary, in order to take full advantage of the concentration of production in the standard ratings and to employ as many interchangeable parts as possible.

Second—Price in such a way that standards are given the full benefit of the manufacturing economies obtained, and specials bear the proper extra price proportional to their higher cost.

Third—Concentrate their engineering talents and manufacturing "know how"

(*Continued on page* 85)

WAR PRODUCTION BOARD
Washington, D. C.

January 19, 1944

My dear Mr. Ferguson:

I am extremely glad to know of the testimonial dinner in honor of the ten employees of the Hartford Electric Light Company having the longest tenure of service, and in particular recognition of the one individual completing fifty years of service.

I shall greatly appreciate it if you will take the opportunity to convey my personal congratulations to these individuals for their extraordinary record with the Company and generally to all your employees for their part in the vital contribution which the electric industry has made to the success of the battle of production on the home front.

The accomplishment of the electric systems of the nation is one of the nation's outstanding jobs in the conversion of our industrial economy from peacetime endeavors to all-out war production. It is a unique and gratifying fact that no single industrial plant or military requirement has ever been held up because of lack of power. This has meant not only providing the facilities to make electric power, but also planning and providing all the facilities to transmit and distribute power to every war activity requiring it. As I have stated on numerous occasions, electric power has never been "too little or too late." This is notably illustrated in the case of your own Comppany which is supplying approximately three times as much electric power for industry as you supplied in 1939.

The employees of the electric industry are deserving of the highest praise and recognition for the great part which they have had in making this remarkable performance possible. While it has not been the practice of the Army and Navy to give "E" awards to service industries such as transportation and utilities, their employees, and in particular the employees of the electric utilities have clearly earned the same high esteem as those working in the plants where the guns, tanks, planes and other implements of war are being produced.

The very fact that your Company has employees of such tenure of service that they are so singularly honored by their fellow employees is a tribute to both the loyalty of the employees and the employee-management relations in the electric industry.

The electric industry and its thousands of employees are deserving of the highest commendation for these achievements on the home front, achievements which are playing such an important part in hastening the day of victory.

Sincerely yours,

J. A. KRUG
Director
Office of War Utilities

MR. SAMUEL FERGUSON
President
The Hartford Electric Light Company
266 Pearl Street
Hartford, Connecticut

Hartford Electric Light Employees Honored

Ten employees of the Hartford Electric Light Co. and two retired members of the organization whose combined length of service with the company totals 434 years were guests of honor at a dinner given recently by their fellow employees in Hartford.

Samuel Ferguson, president of the company, expressed appreciation to the twelve employees for their long and faithful services and presented four of them with service pins. Joseph B. Belanger, who entered the company's employ on January 28, 1894, was given the 50-year service pin; George Bruce received a 40-year service pin, E. V. Ackor received a 30-year pin and Sylvester Barker received a 25-year pin.

Mr. Belanger received a personal letter of congratulations from Gov. Raymond Baldwin of Connecticut, which was read at the dinner.

Messages from J. A. Krug, director of the Office of War Utilities, War Production Board, of Washington, and William H. Mortensen, Mayor of the city of Hartford, were read along with the communication from Governor Baldwin. Both of these letters commended the contribution of the company and its employees to the war effort. Mr. Krug's letter appears above.

The guests of honor and the year in which they entered the company's employ were: Mr. Belanger, Jan. 28, 1894; John E. Lynch, Aug. 9, 1897; E. S. Nutting, March 12, 1899; Charles M. Yale, Dec. 28, 1899; Leonard D. Way, Nov. 21, 1901; Harrison B. Ashmead, March 1, 1902; Andrew G. Steele, Oct. 1, 1902; John Tracy, Jan. 1, 1903; George Bruce, Jan. 1, 1904, and Elliott H. Clapp, July 22, 1905.

Miss Alice M. Baker, retired, who entered the employ of the company on June 15, 1903, and Bert C. Gable, also retired, who joined the company on May 22, 1905, were among the guests of honor at the dinner.

Sidney Z. Mitchell

SIDNEY Z. MITCHELL, for many years an outstanding leader in the electric light and power industry, died at his home in New York on Feb. 17 at the age of 81.

Mr. Mitchell had been inactive in utility and financial circles since 1933, when, after nearly 50 years of work in the industry, he retired on his physician's insistence as chairman of the Board of the Electric Bond & Share Co. and as a director in more than thirty other corporations.

From 1911 to the time of his retirement Mr. Mitchell took a prominent part in the affairs of the former National Electric Light Association, serving on various committees. He was chairman of the Public Policy committee in 1920-1922 and of the Finance Committee from 1925 to 1930.

Mr. Mitchell was born in Dadesville, Ala., in 1862. His parents died before he was 12 years old, and from the time of their deaths he made his own way in the world. He worked his way through a neighborhood country school and a preparatory school at Columbus, Ga. In 1879 he entered the United States Naval Academy at Annapolis on competitive examination and was graduated in 1883.

Desiring to make electricity his life work, he resigned from the navy and went to work in Thomas A. Edison's original Goerck Street plant in New York city. In 1885 he went to Seattle, Wash., with an Edison license. He remained in the Northwest, building, operating and financing electric plants for about 20 years. In 1885 he built the first central station incandescent electric lighting plant west of the Rocky Mountains, and in 1886 he constructed his first hydroelectric plant. In 1905, he returned to New York and participated in the organization of the Electric Bond and Share Company, becoming its chairman in 1923.

At the time of his retirement in 1933, B. C. Forbes wrote of Mr. Mitchell:

"He was an individualist of individualists. He belonged completely to the old school. He had infinite faith in himself, faith in his chosen industry, faith in the future of America. His courage was boundless. His extraordinary brains, his extraordinary capacity for work, his extraordinary stick-to-itiveness won him a long, unbroken series of signal business victories. The word 'defeat' was not in his vocabulary."

Interim Report of the American Research Committee on Grounding

Prepared by the Technical Subcommittee—January, 1944

THE American Research Committee on Grounding was formed several years ago by a group of interested organizations to investigate the subject of grounding electrical distribution circuits for safety purposes, as prescribed by the National Electrical Code, with particular reference to any harmful effects from grounding such circuits on water pipes. The circumstances of the Committee's origin and the scope of its field of investigations are described later in this report.

In carrying out its assignment the committee has followed two main lines of investigation, (1) field studies of specific cases referred to it by operating water companies, and (2) laboratory tests.

In respect to the field studies, the committee has investigated all cases it has been able to learn of and to which it has had access, where impairment of water or water supply facilities has occurred under circumstances such that the water purveyors have suspected that the trouble might have been caused by electric currents resulting from such grounding. Only cases involving alternating current systems have been reported to the Committee.

The Committee is continuing its investigations but a large amount of data has already been accumulated, from which the following findings and tentative conclusions are drawn:

Reproduced herewith is the introductory section and summary of results of the Interim Report of the American Research Committee on Grounding. Copies of the complete report will be available from EEI at a nominal price.

SUMMARY OF RESULTS

General Data

Protective Grounding

Protective grounding of alternating-current secondary distribution circuits has been a recognized practice since 1913. At the present time this practice is almost universal.

Incidental Contacts

In most premises there are incidental metallic contacts between electrical conduit or armored cable and the various building piping systems, which in effect ground the electrical system to the water pipes.

Current on Water Pipes

In general, where there are water pipes in premises supplied by alternating current, part of the current will flow over the water service pipes. This is usually so where more than one customer is supplied from a single transformer as is generally the case in built-up areas such as are served by public water systems.

Current on Gas Pipes

In general the flow of alternating current on gas service pipes was very low. In two cases however, the gas pipes carried substantial current, one of these being a welded main.

Current on Drainage Pipes

In the investigations, drainage or soil pipes were too large in diameter for the use of the clip-on ammeter, but generally the distribution of the test load current was such that it would appear. These pipes did not carry current. In general, soil or drainage pipes of cast iron end about five feet outside the wall of the building being continued with tile pipe.

These items of General Data are discussed in greater detail later in the report.

Classification of Field Cases Investigated

About 100 cases have been investigated by the Committee from 1936 to date.

Impairment of Quality of Water

About a third of the cases investigated were blue water complaints. These cases were mostly at premises with copper tubing in areas served by untreated well water classified as aggressive. The fact that aggressive waters, particularly well waters, may cause blue water with copper or brass piping was, of course, well known in the water works field, but it was not generally appreciated that slightly aggressive or border-line waters could also give trouble. Trouble was experienced regardless of whether the pipes carried current or not. In three cases, current was taken off the pipes but this did not eliminate the blue water condition. In one case where, subsequent to the complaint, the water had been subjected to treatment for reducing aggressiveness, the Committee found the blue water trouble had disappeared.

In the nine cases where rusty water complaints were referred to the Committee, the house piping, and in most cases the service piping, were of copper or brass.

There were only six other cases involving quality of water. Four of these were complaints of taste or odor and two were of sediment in water. In none of these cases was the trouble found to be due to current on the pipes.

Corrosion of Pipes, Tanks, Etc.

Eleven cases related to the failure of copper tubing or high copper alloy hot water tanks. Nine of these failures occurred in two areas. In most cases there was no current on the tank or pipe that failed. The water supply in most of these cases was classified as aggressive.

Troubles on brass pipe (six cases) were mainly leaky joints and dezincification. Investigation of leaky joints indicated that most of them were due to poor workmanship. Dezincification occurred on pipes that did not carry current as well as on pipes that did carry current.

Failure of iron pipes (five cases) mainly involved boiler tubes. The failure was probably due to differential aeration effects or galvanic action between the tubes and the copper heat transfer unit in the boiler.

One failure of lead pipe was due to the corrosive action of free lime in the cement on the outside of the pipe. There was no current on the pipe.

Electric Shock and Sparking

In four cases of electric shock or sparking, two were due to defective wiring and two were due to absence of protective grounding.

Two cases of shock and one of gas ignition by sparking were due to radio grounds on the house piping. In these

cases the current in the grounding conductor was due to a filter condenser in the radio set connected across the power circuit.

Laboratory Tests

Laboratory tests of weight loss of metallic specimens which simulated pipes and laboratory tests on polarization indicated that alternating current did not affect the corrosion of pipes. These tests were made in weak salt solutions.

Findings

1. Grounding of electric power and lighting circuits is necessary for the safety of the customers and their property.

2. In general, grounding to metallic water pipes provides the highest degree of safety. This is because the resistance to ground of such pipes is generally lower than any other grounded metal body present, and for protection by grounding the lowest resistance grounding electrode available should be used.

3. The water piping system is of necessity in parallel with the grounded conductor of electric distribution system. The division of current between the two systems is affected by a number of factors, one of which, but not necessarily a controlling one, is the resistance of the jointing material used in the water mains.

4. In many cases the removal of alternating current from water service pipes or mains is difficult to accomplish.

5. The voltage which produces the current over the grounding conductor and water pipes under normal conditions appears to be of the order of three to four volts. In one instance with a long service entrance cable and water service pipe, approximately eight volts were found.

6. No conclusive evidence has been found to date that alternating current of the magnitude measured by the Committee has any appreciable detrimental effect on the pipes or on the water in the pipes.

7. The galvanic couples which exist in most piping systems, between dissimilar metals, or between dissimilar surface conditions on the same piece of metal, may produce currents in the water which are much greater than those produced in the water by current flowing along the pipes.

8. The troubles from blue water which the Committee has investigated have been found to be due mainly to the action of untreated aggressive well waters on copper tubing. Small variations in impurities permitted in the manufacture of copper tubing seem to affect the extent to which blue water troubles may be experienced.

9. Numerous leaky joints in yellow brass pipe systems were found due to poor workmanship in installation. This gave rise to some dezincification at these joints. Dezincification was also observed in some yellow brass pipes at locations other than joints.

10. If the recognized practice of grounding is not followed, there may be a hazard due to electric shock, ignition of gas and sparking. If the grounding connection is not made on the street side of the water meter, there should be a bonding jumper around the meter to insure continuity of the grounding circuit when the meter is disconnected.

11. In about 10 per cent of the cases, the grounding installations were found to be defective. (For additional comment, see complete report.)

12. In order to insure more effective and permanent grounding connections to water pipes, more satisfactory methods and devices than are now available should be developed.

The evidence on which the above findings are based, the methods employed in the field and laboratory investigations, and related technical information about grounding and electric current distribution, together with the historical background to this subject, are all given in the complete report.

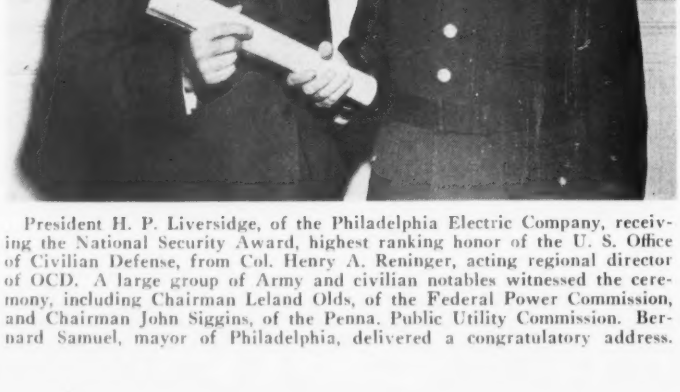
Philadelphia Electric Co. Wins National Security Award

The National Security Award, highest honor within the gift of the Office of Civilian Defense, has been awarded the Philadelphia Electric Company. Formal presentation to H. P. Liversidge, president of the company, was made by Colonel Henry A. Reninger, acting regional director of OCD, at an impressive ceremony in the Broadwood Hotel, Philadelphia, on February 1.

The award "signifies extraordinary achievement in establishing superior security and protection measures against enemy air raids, fire, sabotage and avoidable accidents," Colonel Reninger stated.

Philadelphia Electric employees "by voluntary enrollment and training as members of the United States Citizens Defense Corps," he said, "have evidenced their patriotic zeal in the creation of an efficient organization for the total protection of your facility. The award indicates a fine spirit of cooperation of management and employees beyond the call of routine duty."

John S. Wood, emergency defense coordinator of the company's volunteer defense corps, was appointed on December 15, 1941—eight days after Pearl Harbor. Of the approximately 7,000 employees in the company, 4,933 are enrolled as volunteers and 3,374 have received special training in defense technique.



President H. P. Liversidge, of the Philadelphia Electric Company, receiving the National Security Award, highest ranking honor of the U. S. Office of Civilian Defense, from Col. Henry A. Reninger, acting regional director of OCD. A large group of Army and civilian notables witnessed the ceremony, including Chairman Leland Olds, of the Federal Power Commission, and Chairman John Siggins, of the Penna. Public Utility Commission. Bernard Samuel, mayor of Philadelphia, delivered a congratulatory address.

Progress Report of ASA Electrical Committees

War Work on Increase

THE impact of the war was felt during the past year in the work of the ASA committees on electrical projects, the most active committees being the five which have been working on war standards. These five committees reported 13 war standards completed and approved, and 12 others nearing completion. Committees working on regular standards reported that some of the standards already approved have been useful without change in the war effort, while others have been revised to meet emergency conditions. The demands of war production have handicapped many of the regular committees in carrying on their work and some of them have decided to postpone further activity until the end of the war releases the technicians needed.

Eleven regular American Standards recommended by the Electrical Standards Committee were approved by the American Standards Association during the year, in addition to the 13 war standards.

The reports of the committees given below show how the work is progressing on those projects under the Electrical Standards Committee which are still active. The organizations sponsoring the work are listed following the report of each committee. The names of the chairman and secretary of the committee are given in those cases where the Electrical Standards Committee itself is acting as sponsor.

National Electrical Code (C1)

A technical subcommittee on welding has almost finished a study of welding operations and equipment from the National Electrical Code viewpoint. Preliminary reports on the results of the study already have had wide circulation to the sectional committee. Recommendations of the subcommittee for revisions or additions to the National Electrical Code will be considered by the Emergency Committee. This committee was appointed by the sectional committee to act on Interim Amendments to the National Electrical Code for the duration. A technical subcommittee is being organized to study infra-red lamp heating equipment and suitable safeguards for such equipment. A meeting of the sectional committee will be called at a date not yet determined to consider the next edition of the Code.—*National Fire Protection Association.*

Code for Protection Against Lightning (C5)

During the past two years Part III, covering Protection of Structures containing Inflammable Liquids and Gases, has been under consideration by the sectional committee.—*American Institute of Electrical Engineers; National Bureau of Standards.*

Rotation, Connections, and Terminal Markings for Electrical Apparatus (C6)

A revision of the 1936 edition of this standard has just been approved by the American Standards Association.—*National Electrical Manufacturers Association.*

Insulated Wires and Cables (C8)

In general, the standards prepared by this committee have been found to meet the conditions of war as well as those of peace. Such calls for revision as have been made have been limited for the most part to suggestions for limiting the number of sizes of cable manufactured for general use.

Recent WPB orders to the textile industry have limited the number of threads per inch in cloth available for the manufacture of varnished cloth insulation used in certain types of wire and cable. Technical Committee 7 has made a study of the influence of this order on cable manufactured under American Standard Specifications for Varnished Cloth Insulation for Lead-Covered or Braid-Covered Power Cable (C8.13-1942), and has reported that as yet insufficient data are available to provide a thoroughly acceptable basis for revising or temporarily modifying the standard.

The sectional committee arranged to have strong representation made to a committee of WPB which had proposed certain schedules of conductor size in stranding for the limitation of manufacture. It appeared to the Executive Committee of the sectional committee that these proposals were ill advised and that they would lead both to an increase in the use of copper and to further complication in manufacturing operations. The committee has been advised informally that this proposal has been dropped.

A member of the Executive Committee has represented the sectional committee at several meetings of the Special Committee on Wire and Sheet Metal Gages of Sectional Committee B32. This special committee has been considering a major change in wire gaging systems. The Executive Committee of sectional committee C8 believes that the American Wire Gage and the circular mil sizes of stranded conductors as used for electric power cables represent the results of extended study and constitute a sound system. To disturb them would cause confusion in the industry over a period of many years.—*W. F. Davidson, Chairman; C. S. Gordon, Secretary.*

Radio (C16)

The Sectional Committee on Radio has been inactive for the last year and will doubtless continue so until conditions change.—*Institute of Radio Engineers.*

Industrial Control Apparatus (C19)

A revision of the standard originally approved in 1928 has just been completed.—*American Institute of Electrical Engineers; National Electrical Manufacturers Association.*

Insulators for Electric Power Lines (C29)

A meeting of the committee was held June 30 to consider answers received from members of the committee on a questionnaire on approval of a proposed revision of the Standard on Insulator Tests. During the meeting, thermal shock testing of porcelain and lime glass line insulators was discussed. At the close of the meeting there was still a complete lack of unanimity on the scope and application of thermal shock testing, and it was decided to submit a second letter ballot to the entire committee. The results of this ballot were such that there was little likelihood that this standard could be approved as an American Standard. No decision has been reached as to further steps to be taken to reach agreement on thermal shock testing of line insulators.

The chairman of the AIEE Standards Committee has requested that the ESC Committee on Scope be requested to delete the standardization of roof, floor, and wall bushings and tubes from the scope of the project on Insulators for Electric Power Lines (C29) and include such standardization under the project on Apparatus Bushings (C76). This question is being voted upon by the entire C29 committee.—*J. M. Brundige, Chairman; R. M. Havourd, Acting Secretary.*

Mercury-Arc Rectifiers (C34)

A new chairman, Dr. C. H. Willis of Princeton University, has been appointed, and a complete reorganization of this committee is under way.—*American Institute of Electrical Engineers.*

Railway Motors and Other Rotating Electrical Machinery on Rail Cars and Locomotives (C35-1943)

A revision of the American Standard C35-1936 was approved in January 1943.—*American Institute of Electrical Engineers.*

Power Switchgear (C37)

The subcommittee on power circuit breakers is revising the proposed American Standard for a-c power circuit breakers (C37.4/9). It is expected that a vote on the proposed revision will be taken soon in the sectional committee.

Work on several standards has been deferred awaiting the outcome of AIEE committee work. These include High-Voltage Fuses and Current-Limiting Resistors; Switchgear Assemblies; Metal Enclosed Switchgear; and Automatic Stations. It is understood that work is actively in progress on this last standard.

Certain proposed standards which had been considered by the committee are now inactive, and activity on them at this time

would be premature. These are Air Switches; Large Air Circuit Breakers; Power Connectors; and Network Protectors. —*H. R. Summerhayes, Chairman; G. S. Lunge, Secretary.*

Definitions of Electrical Terms (C42)

This committee has been inactive during the past year, and a complete reorganization will be necessary before activity can be resumed. This will be undertaken when conditions warrant appointment of the large number of men who will be needed in the committee work.

Approximately 16,000 copies of the present American Standard have been distributed.—*American Institute of Electrical Engineers.*

Rotating Electrical Machinery (C50)

Revision of the American Standard for Rotating Electrical Machinery was completed in 1943 and is now in use by industry. The committee is at present inactive, but stands ready to consider any question of interpretation or other questions which may arise. It will also consider comments which are now being received preparatory to the next revision.—*L. F. Adams, Chairman; E. B. Paxton, Secretary.*

Electric Welding Apparatus (C52)

Two subcommittees have been appointed to revise the Standards for Electric Arc Welding Apparatus and Standards for Resistance Welding Apparatus originally issued in 1933. The subcommittee on Electric Arc Welding Apparatus agreed in 1942 that it would be desirable to defer revision of these standards until after the war. The subcommittee on Resistance Welding Apparatus reports that a tentative standard covering all resistance welding apparatus was prepared under the auspices of the War Production Board, and that this will form a nucleus about which the subcommittee will prepare an American War Standard during the coming year.—*American Welding Society.*

Transformers (C57)

The Transformer Subcommittee of the American Institute of Electrical Engineers has had one meeting devoted entirely to bringing its technical information up-to-date and expects to complete its work within the next few months.

Section 4 on Instrument Transformers of the American Standard is being revised by the Instrument Transformer Subcommittee of sectional committee C57. As soon as this work is completed and the recommendations for technical changes are received from the American Institute of Electrical Engineers, it should not take long for the committee to prepare the annual addendum which it is planning to issue on changes in the American Standards for Transformers, Regulators, and Reactors (C57.1-1942; C57.2-1942; and C57.3-1942).—*V. M. Montsinger, Chairman; E. B. Paxton, Secretary.*

Electrical Insulating Materials (C59)

The following ASTM standards were approved as American Standard during the year:

Standard Methods of Testing

Sheet and Plate Materials Used in Electrical Insulation (ASTM D 229-42; ASA C59.13-1943)

Laminated Tubes Used in Electrical Insulation (ASTM D348-42; ASA C59.14-1493)

Laminated Round Rods Used in Electrical Insulation (ASTM D 349-42; ASA C59.15-1943)

Tentative Methods of Testing

Molded Materials Used for Electrical Insulation (ASTM D 48-42 T; ASA C59.1-1943)

Impact Resistance of Plastics and Electrical Insulating Materials (ASTM D 256-41 T; ASA C59.11-1943)

Revisions of C59.13-1943 (ASTM D 229-42) and C59.1-1943 (ASTM D 48-42T) are now again before ASA for approval.

The following ASTM and NEMA standards have been referred to the ASA for approval:

NEMA Laminated Phenolic Products Standards

NEMA Practice for Machining and Punching of Laminated Phenolic Plate

ASTM Methods of Testing Shellac Used for Electrical Installation (D 411-42)

Submittal of NEMA Manufactured Mica Standards to the American Standards Association has been deferred until the supply of mica meeting the specifications is more plentiful.

The sectional committee is now voting on the proposed submittal of the following revised methods to the ASA:

Methods of Testing Electrical Insulating Oils (ASTM D 117-43)

Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (ASTM D 256-43 T)

Work on the List of Available Standards in the Electrical Insulating Field and on the proposed Handbook on Electrical Insulating Materials authorized last year is to be held in abeyance for the duration.

A tentative table of the properties which might need to be measured on synthetic materials applicable in the field of electrical insulating materials, such as nylon, cellulose acetate, fiberglas, pliofilm, duprene, neoprene, vinyon, etc., has been set up. There is a lack of certain test methods for these materials, such as resistance to corrosion and abrasion and evaluation of mildew-proofing agents. Since any synthetic or new materials of any real value are confidential, however, consideration of such tests is being postponed.—*American Society for Testing Materials.*

Lightning Arresters (C62)

The committee is now balloting on approval of a revised standard to clear up disagreement between manufacturers and the power group.—*American Institute of Electrical Engineers.*

Carbon, Graphite and Metal Graphite Brushes (C64)

A committee is now being organized to handle a revision of the American Standard. —*National Electrical Manufacturers Association.*

Preferred Voltages, 100 Volts and Under (C67)

A meeting of this committee was held November 4. Very satisfactory progress was made, and the committee hopes to submit a final report during the coming year.—*C. A. Powel, Chairman; C. M. Cogan, Secretary.*

Sphere Gap Standardization (C68)

Since a revision of AIEE Standard No. 4, Measurement of Test Voltages in Dielectric Tests, was approved by the ASA last year, the problem of measurement of test voltages is probably taken care of for a while at least. The next revision will undoubtedly not take place until after the war, at which time a comparison can be made with the sphere-gap values of other countries with a view to establishing uniform international calibration curves.

The question of "front-of-wave testing" of power station apparatus and transmission line insulation has created the problem of voltage measurements and wave recording of impulses of the order two microseconds duration and less. The NEMA-EEI Subcommittee on Correlation of Laboratory Data had this task as one of its last assignments. The completion of this will have to await a decrease in the pressure of the war effort on the several laboratories involved, and their staffs. The results of this work can probably be considered for inclusion in the next revision of the standard.

The members of the subcommittee are now being circularized for suggestions on work to be done by the group during the coming year, or in the future.—*American Institute of Electrical Engineers.*

Domestic Electric Flatirons (C70)

The manufacture of domestic electric flatirons has been stopped by government order since April, 1942, and there is no present indication as to when it will be resumed. The manufacturers feel that the completion of this standard may well proceed slowly until reconversion of the industry to the manufacture of civilian products is in sight, and those who are most capable of developing a new standard are again working on appliance assignments.—*National Electrical Manufacturers Association.*

Household Electric Ranges (C71) Electric Water Heaters (C72)

Progress is being made on the drafting of these standards.—*National Electrical Manufacturers Association.*

Wood Poles (O5)

There has been no change in the status of this project during the past year. Standards already approved by the American Standards Association have been used by the War Production Board in its order RMPR-284.—*ASA Telephone Group.*

Letter Symbols and Abbreviations for Science and Engineering (Z10)

During this past year, the American Standard Letter Symbols for Heat and Thermodynamics was approved and published. Active work is now going forward on Symbols for Electrical Quantities and on Symbols for Radio.

During the past year the Symbols for Structural Analysis have been circulated for criticism, and a report is expected soon.—*American Association for the Advancement of Science; American Institute of Electrical Engineers; American Society of Civil Engineers; American Society of Mechanical Engineers; Society for the Promotion of Engineering Education.*

Graphic Symbols and Abbreviations for Use on Drawings (Z32)

This committee is actively at work, having completed three standards during the past year. All three have been approved as American Standards. They are: American Standard Graphical Symbols for Power, Control, and Measurement (Z32.3-1943); Symbols for Telephone, Telegraph, and Radio Use (Z32.5-1943); and Graphical Electrical Symbols for Architectural Plans (Z32.9-1943). The committee is now engaged in eliminating a few conflicts which exist between these standards.—*American Institute of Electrical Engineers; American Society of Mechanical Engineers.*

Electrical Equipment Committee Meeting

R. T. Henry, *Chairman*

THE winter meeting of the Electrical Equipment Committee was held in the Hotel Netherlands Plaza in Cincinnati on February 14 and 15 with about 60 members and guests in attendance. The usual morning and afternoon sessions were supplemented with an evening session on the first day. One session was held jointly with the Transmission and Distribution Committee and featured a discussion of preferred ratings for nominal system voltages. The two Committees held a joint luncheon on Tuesday at which they were addressed by Mr. S. M. Dean, Chief Engineer of the Detroit Edison Company, on the subject of Settling Pre-war Problems for Postwar Use.

In the closed session Monday morning the discussion of apparatus trouble was largely devoted to recent failures of 3600 rpm, hydrogen cooled generators.

Progress of the work on uniform requirements for metal-clad switchgear was reviewed by Mr. Shew with particular reference to a questionnaire shortly to be set to Committee members. Mr. Wilbraham announced that this activity had been discussed with the EEI-AEIC-NEMA Joint Committee on Power Circuit Breakers, and that the Triple Joint Committee would take over sponsorship of the work as soon as the utility requirements had been determined well enough to justify Joint Committee action.

Mr. Henry reported that the proposed revision of the ASA circuit breaker standard had recently received approval on all points except that relating to the limitation on control voltages. A meeting of the Circuit Breaker Subcommittee is to be held soon to consider this matter further.

Mr. Oldacre, Chairman of the AIEE Group of the AIEE-ASME Joint Committee on Turbo-Generators, presented a report on this work. This supplemented a previous report presented at the recent Winter Technical Meeting of the AIEE held in New York, and reflected the discussion at that meeting. On the basis of the information which the Committee has accumulated to date, it interprets the needs of a majority of users to be as follows: (a) the generator should be capable of delivering rated turbine output at about 80 per cent power factor even though the turbine has only 10 per cent excess capacity as proposed by the ASME Committee; (b) the generator should be capable of delivering maximum turbine output at about 90 per cent power factor. Two methods of meeting these requirements were suggested for consideration. Mr. Oldacre emphasized that one of the chief purposes of the report was to stimulate discussion and urged that those interested send him their comments to assist the Committee in its work.

System generating capacity reserves were discussed by Mr. Mayott. He reviewed the outstanding job that the utilities had done in carrying the load during the war emergency with greatly restricted reserves. While it was anticipated that the minimum reserves provided for the war period might result in the necessity for load curtailment in certain areas, such curtailment for lack of generating capacity had fortunately not proved necessary. Important factors in this result were the ample reserves provided in the prewar period, coordinated action of interconnected systems, and the margins available in equipment.

The new Chesterfield Power Station was described by Mr. F. H. Spies superintendent of the station. This station had to be constructed at a time when the situation in regard to materials and equipment was the most acute of the entire war period to date. In consequence, the discussion was of particular interest in illustrating the departures from conventional practices dictated by the war emergency conditions.

Mr. C. E. Bathe presented, on behalf of Mr. W. H. Stueve, a paper on the Power Supply To The Big Inch Pipe Lines. This paper was of interest not only because of the unique features of the project but also because of the further illustrations of the use of substitute materials and simplified design required by war conditions.

Joint Session of Electrical Equipment and Transmission and Distribution Committees

Mr. Seelye, acting Chairman of the EEI Group in the EEI-NEMA Joint Committee on Preferred Voltage Ratings, presented a table of nominal system voltages which had been tentatively adopted by the Joint Committee. He pointed out that this table would serve as a basis for future work of the Committee in establishing preferred voltage ratings for specific classes of equipment. It was, therefore, especially important that it have careful consideration by the Electrical Equipment and Transmission and Distribution Committees. Following active discussion by several members, Mr. Seelye urged that if anyone had additional comments they send them to him promptly so that they might be taken into account before a table of nominal voltages was finally adopted.

Supplementing discussions at previous meetings, Mr. Gaty reported on the progress in Postwar System Planning in Philadelphia.

Mr. Gaty also discussed the use of radio by power companies for trouble dispatching and described the activities of the Radio Technical Planning Board. This Board was organized under the sponsorship of the Institute of Radio Engineers and the Radio Manufacturers Association, at the original suggestion of Chairman Fly of the Federal Communications Commission. The purpose of the Board is to formulate plans for the technical future of radio with particular reference to frequency allocation and system standardization and to submit its recommendations to the FCC. Mr. G. H. Underhill, of the Central Hudson Gas and Electric Company, has been appointed to represent the EEI on the Board. The work of this organization is to be carried out by 13 subcommittees or panels. Of these, the panel dealing with Portable, Mobile, and Special Emergency Service is of particular importance to electric utilities. Both the EEI and AEIC have several representatives on this panel, who, together with representatives from publicly owned utilities, constitute an Electric Utility Group under the chairmanship of Mr. R. V. Dondanville of the Commonwealth Edison Company.

Accident Prevention Committee Meeting

H. O. Sprinkle, *Chairman*

ONE of the highlights of the well attended and instructive meeting of the Accident Prevention Committee held at the William Penn Hotel in Pittsburgh February 11th and 12th, was the immediate and unanimous approval of a subcommittee report by Messrs. Stewart, Rogers and Kreh, recommending a constructive and comprehensive program designed to aid safety men and increase interest in accident prevention work throughout the industry.

A series of helpful letters and suggested outlines for Safety Talks and Group Discussions are to be developed by the Committee and offered without charge to safety supervisors who may care to use them. Letters and discussions will cover timely subjects chosen for their importance as revealed by analysis of the industry's accident experience. Significant data based on these statistics will be supplied with suggestions of proven merit that may be used by safety supervisors in preventive efforts either in whole or part, or adapted to accommodate their own local needs.

The possibility of the committee developing a series of appropriate Industry Safety Posters was also discussed. This idea was well received and Mr. W. R. Smith will look into the matter further for the committee and report at a later meeting.

Desirable changes in the form and method of collecting and reporting accident statistics were presented by Mr. E. J. Kheh. These changes were approved by the committee substantially as made. The proposals were developed through joint conferences between representatives of AGA, EEI and NSC, and provide for further simplification of the reporting form and a more natural grouping of the information reported. Provisions will also be made enabling combination companies to report their accident experience under specific group headings when practicable, or in a separate section of the form provided for use when it is impossible to allocate an accident to a specific industry group classification.

The actual company reports submitted by the industry will be summarized and incorporated into an annual report as in the past. The Annual Statistical Report is to be expanded somewhat, however, to include trend charts, observations of significance and conclusions based on an analysis of the summarized individual reports.

Mr. D. C. Stewart will continue his study and analysis of Fatal and Lost Time Accidents. This is one of the most important activities of the committee. Tabulations showing the results of these analyses are given wide distribution and serve as a guide in determining where accident prevention efforts are most needed.

Detailed reports are obtained on fatal accidents and these are closely examined to determine causes and practical preventive measures that may be taken to avoid similar occurrences. Reports on lost time accidents are submitted by committee members. These are also examined carefully for the same purpose. All are finally grouped and tabulated under natural headings. Copies of these tabulations showing the results of the analysis are then published in the EEI BULLETIN with observations and suggestions and are also sent to all safety supervisors for their information and guidance.

These tabulations furnish convincing supporting evidence indicating whether changes in design or in practices seem to be desirable. Many of the working tools and protective devices are greatly affected these days by limitations and restrictions necessitated by wartime conditions. Practices must, therefore, be constantly watched to see that hazards are kept as low as possible and that the most effective use is made of the materials and means available. The committee is regularly informing the industry of the best thoughts along these lines.

One of the most recent EEI publications is a new and inmproved "Line Clearance Manual for Overhead Electric Conductors" (Pub. K-10). This Manual, prepared by the Overhead Distribution Group Tree Clearance Subcommittee of the Transmission & Distribution Committee, does not entirely replace the earlier publication of the Joint Accident Prevention and Transmission and Distribution Committee Report "Tree Trimming Practices" (Pub. F-10), but is intended to serve as a more recent guide to foremen and others interested mainly in the economic aspects of securing proper clearances of overhead lines from trees. The text of the new manual was cleared through the Accident Prevention Committee and no conflict was found with any of the safe practices outlined in the earlier publication which will continue to serve as a guide in this respect.

Another item of considerable interest was a tentative proposal suggesting extension of the present EEI one million man-hour safety merit award conditions that would make it possible to give the smaller companies an award in recognition for substantial accident free experience without having to accumulate the one million man-hours necessary to qualify under the present award conditions. A subcommittee consisting of Messrs. Ruoff and Godwin is to continue to explore this possibility in joint efforts with AGA where similar interest exists. The committee did decide, however, to recommend that in cases where a company qualified for an award for two or more consecutive million man-hour periods that a new certificate be awarded indicating the cumulative total of million man-hours, instead of issuing another one million man-hour certificate.

Reference was made to the growing use of 230 volt and 460 volt circuits in industrial plants and the possible increase in hazards from circuit voltage contacts that may result due to grounding. It was noted that opinion appears to be divided as to the advisability of grounding such circuits. The committee members were requested to give the matter some thought and make an informal check on the situation in their companies. Mr. Stewart agreed to contact them later to obtain their views. The results of this quick survey will serve as a guide to the Chairman who plans to take the matter up with the Chairman of the other interested committees to see if a joint committee to consider the matter further is deemed desirable.

Mr. Boulet agreed to assemble information to enable him to prepare an article on possible ways to use the Accident Prevention Committee's analysis in individual Company safety programs.

It was also decided to inaugurate an information exchange news letter service for the purpose of bringing to the attention of committee members from time to time unusual circumstances involving accidents and any other matters of special

interest deemed appropriate for inclusion in such a letter. Mr. W. R. Smith agreed to sponsor this activity temporarily and all committee members were requested to send him any items they considered of sufficient interest for this purpose.

Mr. E. C. Rue reported that he thought it advisable to discard the plan to the possible harmful effects of counter as such and instead prepare a complete report on one subject at a time. He then presented a detailed and generously illustrated Provisional Report on "The Application and Care of Rubber Protective Equipment." Copies were given to the members for review and they were requested to send in their comments or suggestions before March 15th.

A report on linemens cutout accidents is expected to be ready to be presented by Mr. H. H. Berman at the May meeting.

Mr. W. R. Smith discussed resuscitation practices with particular reference to the possible harmful effects of counter shock as an aid in revising sensory shock cases. He indicated that in general counter shock is frowned upon by medical authorities because of the possibility of causing lasting harmful effects. Mr. Smith also discussed the use of mechanical resuscitation equipment. He called attention to the fundamental need for the inhalator in serious cases of carbon monoxide poisoning, but emphasized the importance of prone pressure resuscitation being started immediately in all cases of suspended respiration. This is vital in electric shock cases because of the importance of the time element. Leading physiologists recommend reliance on manual techniques in preference to mechanical devices which are considered more appropriately used, in operating rooms or elsewhere where needed, by professional medical personnel.

Mr. C. N. Rakestraw reported on the progress made in the development of a Firemen's Handbook. Suggestions were made that emphasis should be placed on how firemen should protect themselves when fighting fires in the vicinity of live lines and equipment rather than attempt to acquaint them with details of construction and types of apparatus in various voltage classifications. Mr. Rakestraw will make a further report at the next meeting.

Mr. W. T. Rogers, reporting for the Publicity Subcommittee, reviewed the work done during the past year. He stated that 16 articles on accident prevention subjects were prepared and published in the BULLETIN last year and six reprints were distributed by EEI. His suggestion that copies of articles already published be assembled in a single folder and distributed to safety men, was approved. He indicated that further articles on accident prevention subjects will be prepared and published in the coming months.

Mr. R. M. Godwin, reporting for the subcommittee on rubber goods, stated that no change in the quality of rubber gloves and sleeves was expected in the immediate future. However, due to the reduced allocations of crude for use in such goods, line insulator hoods, hose and blankets are now being made of half crude and half synthetic, but it is expected that before long these products will have to be made entirely of synthetic rubber. Tests have shown that ample dielectric strength can be provided, but the articles will be heavier and not have the desired mechanical characteristics of crude rubber.

Reference was made to recent WPB restrictions on the use of leather which may exclude its use for linemen's belts. There was some doubt as to the exact meaning of the order and the Chairman agreed to make inquiries about this and will inform the committee members as soon as he can obtain an interpretation.

Transmission & Distribution Committee Meeting

Frank Sanford, *Chairman*

THE marked interest in the work of the Transmission and Distribution Committee was evident in the record attendance at the meeting held at the Netherland Plaza Hotel in Cincinnati on February 14 and 15. A total of 143 members and invited guests registered and all sessions were well attended.

The morning session of the first day was devoted to Standards and Specifications with Mr. T. J. Brosnan, Group Sponsor, presiding. Mr. Brosnan reviewed the work of this group and outlined plans to obtain more general acceptance of the standards developed by the committee.

Mr. Nimmer discussed "Effective Standardization of Materials," referring to difficulties often encountered and suggesting ways in which they may be overcome. He pointed out that it was quite natural for different persons to place different values on the various factors involved in standardization. Some strive primarily for material perfection, others try to obtain long life material, and still others are concerned mostly with costs. To obtain effective standardization it is, therefore, necessary to consider all points of view impartially and realistically. He said that suggestions and constructive criticism should always be welcomed as an aid in developing a really strong standard, and expressed the belief that if the essential features and resulting benefits were made known to all individuals concerned, including department heads and purchasing agents, there would be little difficulty in obtaining universal acceptance of the standards.

Referring to the definite material benefits to be derived by the adoption of industrial standards even for the smaller items, he cited the experience of his own company where a careful elimination of all excess and duplicate items resulted in a reduction of inventory of about $250,000. He declared it has been their practice to approve wholeheartedly the standards prepared by the Transmission & Distribution Committee and that with few exceptions they are in full effect and have resulted in substantial economies. Central engineering groups are responsible for the preparation and issuance of material standards and specifications in cooperation with the proper division personnel. General conferences are held several times a year, at which time proposed standards are presented for comment. If the conference approves the standard, it is then formally incorporated in the list of approved materials and placed in the hands of all division engineers and purchasing agents. Requests for non-standard items not on the approved materials list are referred to the Central Engineering Department for review. Thus reasonable control of purchases and the economic use of materials is assured.

Mr. Brosnan urged all who felt the need for additional standards to let him know so that the requests might be considered by the standards and specifications working group.

Mr. J. M. Wallace of Westinghouse Electric & Manufacturing Company,

discussed "Fusing Practices on Distribution Systems." He reported that the results of a survey of about 200 operating companies revealed a wide variety of fusing practices in distribution systems below 5 kv. Replies from 167 of the companies showed that about 10 per cent use a 2 ampere link as the smallest size, while about 2 per cent will use nothing smaller than a 40 ampere link. A check of fusing ratios showed that these have increased considerably in the last 10 years. One of the most frequent comments received from the questionnaire was a request that fuse-links of different manufacture but of the same rating, be completely interchangeable. Mr. Wallace believed that when this standardization is reached more consistent fusing practice will be possible.

A report of the EEI Street Lighting Committee by Mr. O. K. Cornell reviewed the substantial progress made to date. The report indicated that work had been completed on Basic Design Voltages and on Standardization of Lamps For Series and Multiple Street Lighting Service. The joint committee has also made considerable progress on the section dealing with Luminaires, one of the most difficult in view of the problems faced by manufacturers because of the need for agreement on uniform dimensions. Some preliminary work has been done on Luminaire Supports and work on Protective Equipment will follow. The sincere willingness of manufacturers to cooperate in all these efforts has greatly aided the work of the committee. Progress at present however is slow because manufacturers' engineers are almost completely occupied with war work.

Following the reading of Mr. Cornell's report, Mr. E. H. Richter discussed the effect of high temperatures on sockets and receptacles and also on insulation. Mr. George A. Eddy of the General Electric Company, Chairman of NEMA Street Lighting Technical Committee, then spoke on what standardization of street lighting equipment would mean to the manufacturer and also discussed the prospects for standardizing this equipment before peace-time production is resumed.

Mr. E. D. Brown reviewed the work done thus far to standardize mountings for cutouts and lightning arresters. A canvass of manufacturers made late in 1941 revealed a wide range in design, but as the various types of clamps and hangars were relatively inexpensive and at present are purchased as a part of the arrester or cutout units, it was believed that little saving could be effected by standardizing the mountings before the number of types of units were reduced. Because of this and war-time conditions in 1942 it seemed advisable to temporarily defer further study. However, new interest in this matter is again indicated and the subject will probably be considered further in the near future.

Mr. Sanford again reminded those present that this committee's approval of the Type "E" Distribution Fuse was withheld pending consideration of additional desirable features by the subcommittee. He said because of this there is as yet no approved Type "E" Distribution Fuse Standard as far as the Transmission and Distribution Committee is concerned.

Mr. Sanford then reviewed the committee's present activities, policy and future plans. (For a complete report on Mr. Sanford's remarks see "Outline for Distribution Planning" which appears in this edition of the BULLETIN.)

NOTE: The joint meeting with the Electrical Equipment Committee during the afternoon of the first day is covered in the report of that committee appearing in this issue of the BULLETIN.

Overhead subjects were discussed during the morning session next day, Mr. Brown presiding in the absence of Mr. Gundlach, Overhead Group Sponsor.

Mr. J. B. Hodtum, Allis-Chalmers Manufacturing Company, presented a paper on "Distribution Transformer Protection Problems," a copy of which appears in this edition of the BULLETIN. During the discussion which followed, it was remarked that too heavy fusing may lead to bushing failures and perhaps long interruptions. One company reported that fewer fuse failures occurred with transformer tanks ungrounded.

Mr. C. H. Leatham, Chairman of the EEI Farm Utilization Committee, discussed the present and anticipated demand for power in rural communities and the types of service that will probably be needed. Real interest was evident in future developments in this field as it is recognized that increased farm income will mean much greater use of electricity in these areas. Another indication that farm loads will increase rapidly is the great interest being taken in the development of electrically driven productive farm machinery. A survey by EEI late last year showed the demand for electrification then was for 36,000 miles of lines to serve 146,000 customers, with construction costs estimated to be about 47 million dollars. Only the lack of men and materials seem to be keeping many companies from extending their lines now.

During a round table discussion on operating experience with rural lines, Mr. C. E. Bathe presented a paper describing his company's experience with about 2400 miles of rural lines in Oklahoma and Arkansas. Mr. Bathe described the different types of construction used successfully in both medium and heavy loading areas and also told of extensive troubles with severe glaze storms.

Mr. W. R. Bullard discussed "Long-Span Farm Lines," describing his company's experience with more than 10,000 miles of circuit consisting mostly of one live conductor and a grounded neutral. The voltage of most of these lines was in the 6600 to 7620 (line-to-ground) voltage class. Normal span lengths varied from 250 feet to 800 feet and poles in general were of small diameter and 30 or 35 feet in length. Mr. Bullard reported that these lines stood up as well and sometimes better than conventional short-span lines. Some trouble was experienced with high-frequency vibration but this condition was greatly alleviated by resagging the conductors, using armor rods at points of attachment, special non-rigid and non-abrading ties and dead ends, use of flexible tap connections, and by avoiding heavy splices. Telephone coordination of the lines was easily effected, the most satisfactory remedy being to metallicize the telephone return path. The cost of operation of the long-span farm lines was about the same as that of conventional types.

Mr. W. R. Doar told of his company's operating experience with approximately 6000 miles of rural line in North Carolina. Single phase, 6900 volt, pole top pin common neutral construction is used in most cases. This type of line also has proven very satisfactory. Various conductor types are used depending upon which is most economical for the particular purpose. Most of the transformers are protected with double spill gaps and internal fuse links, with pole top reclosers used to clear the arc following lightning discharges. About 200 reclosers are used and it has been found that they give very satisfactory service when properly applied, installed and maintained.

At a joint luncheon with the Electrical Equipment Committee Mr. S. M. Dean of the Detroit Edison Company addressed the members informally on "Settling Pre-War Problems for Post-War Use."

During the afternoon session, Mr. Andrew Bodicky, Underground Group Sponsor presided. Mr. G. B. Shanklin of the General Electric Company presented a paper on "Future Trends in Cables For Distribution Voltages." Mr. Shanklin reviewed some of the more promising developments and trends in primary and secondary distribution cable practices making special reference to the merits and use of various synthetics for protective covering and also for insulation purposes. A copy of this paper will appear in an early issue of the BULLETIN.

Mr. T. G. Hieronymus presented a paper describing "Studies of Earth Ambient Temperatures" conducted by his company to determine more exactly the amount of current that could be safely carried on underground paper insulated, lead covered power cables.

Mr. George A. Lineback described a new cable pulling compound containing a permanent corrosion preventing element and that also prevents electrolytic removal of lead by stray currents, etc. It was claimed that tests over a period of six years showed that the inhibiting principle is permanent under all ordinary conditions met in underground ducts.

A Progress Report on a Study of 1942 Cable Operation by Mr. C. M. Mosher indicated that cable and joint trouble rates for this period were the lowest reported to date.

PERSONALS

JAMES A. GALVIN has been appointed acting publicity director of the Boston Edison Company in place of JAMES V. MACDONALD, now in U. S. Navy service. Mr. Galvin has been with the company since 1921, and for the past five years has been assistant to John J. Buckley, superintendent of the public relations department. He will continue in the latter position. MELVIN H. BROOKS, since 1936 in the claim division and for 17 years before that in the transmission and distribution department, has been named assistant head of the former division. He joined the company in 1919.

THOMAS E. NOLAN, who entered the company's service in 1920 and has been active in its steam plant operations, has been made head of the steam division at the new Mystic station in Everett, FRANCIS H. DANOLDS becoming assistant head of that division. Mr. Danolds became an Edison man in 1911. EDWIN C. QUINN, in the production department since beginning Edison employment in 1918, has been named assistant head of the steam division, Charles Leavitt Edgar station, North Weymouth, succeeding the late W. A. Reynolds. LAWRENCE B. HOWARTH, with Boston Edison since 1925 in the standardizing and testing laboratory and then with the production department, has been named assistant head of the southeastern division with headquarters at Roslindale. He replaces E. J. Antonia, on military leave of absence.

J. HAYWARD HARLOW has retired from the Philadelphia Electric Co. after more than 21 years of continuous service with that utility and its Maryland subsidiaries. About 1902 Mr. Harlow became interested in engineering projects on the lower Susquehanna River and made many studies on power sites. In 1908 when the Susquehanna Power Co. was formed, he continued such work with that company for a few years. From 1911 to 1922 he was president and general manager of the Havre de Grace Electric Co., when he became permanently associated with the Susquehanna Power Co. as engineer. Upon completion of the Conowingo plant, he joined the Philadelphia Electric Co., real estate department. In 1937 he was transferred to the Susquehanna Electric Co., Conowingo hydro plant, as property agent.

WILLIAM M. HICKEY, president of United Corporation, has been elected a director of the Columbia Gas & Electric Corp. He is also a director of the United Gas Improvement Co., Public Service Corp. of New Jersey and the Brockton (Mass.) Gas Light Co.

JACKSON T. MURPHY, chief statistician of the Jersey Central Power & Light Co., Asbury Park, N. J., has been elected assistant secretary of the company. Mr. Murphy has had 28 years of service with the utility, starting in Red Bank as chief clerk in the power station. He was transferred to the general office in 1925 where he headed the statistical department.

GEORGE U. PARKS, assistant general manager, Montaup Electric Co., Somerset, Mass., since its establishment in 1925, has been appointed general manager. LOUIS F. EATON, lately assistant to the vice-president in charge of electical operation and sales, Blackstone Valley Gas & Electric Co., Pawtucket, R. I., and previously with the Stone & Webster Service Corp., Boston, and the Brockton (Mass.) Edison Co., has been named assistant general manager at Montaup.

A. RAYMOND CUMMING, formerly commercial cooking engineer, has been appointed personnel assistant to the general superintendent of production, United Illuminating Co., New Haven and Bridgeport, Conn.

He will be responsible for maintaining the job classification record and for assisting in the preparation of new job memoranda, besides being available for consultation on personnel matters and active in the coordination of production employee training and educational programs.

ROBERT B. STUART, JR., sales manager Blackstone Valley Gas & Electric Co., Pawtucket, has been elected president of the Electrical League of Rhode Island, succeeding John E. Marshall. Aime Paulhus of the above utility, A. V. Bartlett, Rust Electric, Providence, and H. R. Tracy, Tracy & Co., Inc., Providence, have been named vice-presidents, J. G. Armstrong and H. E. Dawson, both of Narragansett Electric, Providence, being respectively treasurer and secretary-manager.

W. C. MULLENDORE, executive vice-president of the Southern California Edison Co., has been elected president of the Los Angeles Chamber of Commerce for 1944. Mr. Mullendore has had a long career of leadership in Los Angeles civic activities. His interest in Chamber of Commerce activities is state and nation wide. He is a member and a former vice-president of the U. S. Chamber of Commerce and vice-president and a director of the California State Chamber of Commerce.

RALPH H. LIGHTNER has resigned as industrial sales manager of the Keystone division of the West Penn Power Co., Ridgway, Pa., to take a position with the Titan Metal Manufacturing Co., at Bellefonte. L. R. COLE of Pittsburgh has been appointed to the newly created job of division sales manager of Keystone. Mr. Cole joined the West Penn staff in 1928 as a serviceman in the meter department. His later experience has been in sales engineering and promotion in the commercial customer and industrial customers' department in Pittsburgh. He is a member of the Illuminating Engineering Society and the Pennsylvania Electric Association. The purpose of the newly organized set-up in Keystone is to co-ordinate all sales promotion under one head. Mr. Cole will assume the industrial sales responsibilities formerly handled by Mr. Lightner and, in addition, will be responsible for co-ordinating and directing all other sales and sales promotion activities in Keystone.

J. W. CRUSE, formerly Talladega district manager of the Alabama Power Co., has been appointed Tuscaloosa district manager succeeding T. L. BEAUCHAMP, who will remain with the company in an advisory capacity. Succeeding Mr. Cruse at Talladega is E. O. HUSEY, formerly Demopolis district superintendent.

ROY C. SLACK, who has been with the American Gas & Electric Co. system for 19 years, 12 years with the Appalachian Electric Power Co. and for the past seven years with the Atlantic City Electric Co., has joined the engineering staff of the American Gas & Electric Service Corp. in New York.

TOM E. SHEA has been appointed executive assistant of the Northwestern Electric Co., Pacific Power & Light Co. and the Portland Gas & Coke Co. He will serve the three Portland, Ore., companies jointly, working with the managements in preparing various studies and reports under the general supervision of John Dierdorff, advertising supervisor. For the past four years, Mr. Shea has been manager of the Oregon Motor Transport Association and for a number of years prior to that was editor of the *News-Telegram* of Portland before its purchase by the *Journal*.

Electric Steel Production Makes New High Record

Production of electric steel furnaces reached a new high figure of 4,600,000 tons in 1943, according to preliminary estimates of the American Iron and Steel Institute. This represents an increase of 625,000 tons, or 16 per cent of the production during 1942. At the same time, the annual capacity expanded from 4,555,000 net tons per year on December 31, 1942, to 6,315,000 tons on December 31, 1943, representing an increase of 1,760,000 tons or 39 per cent. The percentage of the total output of steel produced in electric furnaces has risen from two per cent in 1939 to five per cent in 1943. Table I shows capacities and output of electric steel during recent years.

It will be observed that electric steel capacity is now six times prewar (1939) production.

In addition to the production shown by this table, the use of electricity in the manufacture of the ferro alloy ingredients themselves is of even greater importance. Production of ferro-alloys was nearly 9% larger in 1943 than in 1942, or slightly less than half the rate of increase in the output of alloy steel. Much of the difference between these two increases appears to result from the larger proportion of low-alloy steels. The production of ferro-alloys during recent years is estimated in Table II.

Using an average figure of 860 kwhr per ton of electric steel and 6,300 kwhr per ton of ferro-alloys produced in electric furnaces, the total consumption of energy in recent years is shown in Table III.

CONVENTIONS AND MEETINGS

MARCH

8 Electric Companies Advertising Program, Management Group, Palmer House, Chicago, Ill.
9 Council of Electric Operating Companies, Palmer House, Chicago, Ill.
9-10 Rate Research Committee, EEI, Statler Hotel, Cleveland, Ohio.
21 The Electric Institute of Washington, Hotel Statler, Washington, D. C.
23-24 Southeastern Electric Exchange, Engineering and Operation Section, Henry Grady Hotel, Atlanta, Ga.
26-28 North Central Electrical Industries, St. Paul Hotel, St. Paul, Minn.
30 Electric Companies Advertising Program, Copy Group, New York, N. Y.

APRIL

3-5 American Society of Mechanical Engineers, Spring Meeting, Birmingham, Ala.
3-5 Eleventh Annual Commercial Meetings, EEI, Edgewater Beach Hotel, Chicago, Ill.
6-7 Missouri Valley Electric Association, Engineering Conference, Continental Hotel, Kansas City, Mo.
12 Electric Companies Advertising Program, Management Group, New York, N. Y.
13-14 Midwest Power Conference, Palmer House, Chicago, Ill.
19-20 Missouri Association of Public Utilities, Annual Business Meeting, Jefferson Hotel, St. Louis, Mo.
19-22 National Electrical Wholesalers, Second War Conference, Stevens Hotel, Chicago, Ill.
23-27 National Electrical Manufacturers Association, Chicago, Ill.
26-27 Gas and Electric Industry Accounting Conference, Hotel Cleveland, Cleveland, Ohio.
27 Electric Companies Advertising Program, Copy Group, New York, N. Y.

MAY

1-4 Technical Committee meetings, EEI, Edgewater Beach Hotel, Chicago, Ill.
8-11 National Fire Protection Association, Benjamin Franklin Hotel, Philadelphia, Pa.

JUNE

6-7 EDISON ELECTRIC INSTITUTE, Annual Conference, Waldorf-Astoria Hotel, New York, N. Y.
5-7 Public Utility Advertising Association, Chicago, Ill.
19-22 The American Society of Mechanical Engineers, Semi-Annual Meeting, Pittsburgh, Pa.
22-23 Canadian Electrical Association, Annual Meeting, Murray Bay, Que., Can.

TABLE I

Year	Capacity (Dec. 31) (Thousand Net Tons)	Output (Thousand Net Tons)		
		Carbon Steel	Alloy Steel	Total Electric
1939	1,883	280	749	1,029
1940	2,586	413	1,287	1,700
1941	3,738	407	2,462	2,869
1942	4,555	582	3,393	3,975
1943 (est.)	6,315	600	4,000	4,600

TABLE II

Year	Ferro-Alloy Statistics		
	Production* (net tons)	% by Electricity (estimated)	Electric Furnace Production (net tons)
1939	620,000	36%	224,000
1940	780,000	37%	289,000
1941	1,190,000	39%	464,000
1942	1,420,000	42%	600,000
1943	1,550,000 (est.)	45% (?)	700,000

*U. S. Bureau of Mines. Figures published by American Iron & Steel Institute are somewhat larger.

TABLE III

Year	Carbon Steel	Alloy Steel	Ferro-Alloys	Total
	Millions of Kilowatthours			
1939	241	644	1,415	2,300
1940	356	1,081	1,813	3,250
1941	350	2,117	2,933	5,400
1942	501	2,918	3,781	7,200
1943	516	3,440	4,394	8,350

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Post War Planning Committee, H. C. THUERK, New Jersey Power & Light Co., Dover, N. J.

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Prize Awards, P. S. YOUNG, Public Service Electric & Gas Co., Newark, N. J.

Rate Research, F. A. NEWTON, The Commonwealth & Southern Corp., New York, N. Y.

General Commercial, EDWIN VENNARD, Middle West Service Co., Chicago, Ill.

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